The Glass Industry

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The Electro Deposition of Silver and Copper on Glass

By CHARLES H. PROCTOR

The introduction of silver deposits upon glassware from Europe nearly twenty years ago gave the first impetus to the metalizing of glass in this country. Silver deposits have been applied to all types of household glassware in endless varieties, the white color of the silver and the lustre of the glass giving a splendid combination that has been prized by lovers of the artistic in glassware decorations. The demand for silver deposited ware keeps normal and in the lapse of years since its introduction it has been constantly in demand and has become a standard product.

Mirrors are now exclusively coated with silver to give the desired reflection. Years ago tin and mercury were used as an amalgam for coating mirrors. The silvering of glass for mirrors is purely a chemical one. By the interaction of the various chemical agents, the metallic silver becomes precipitated upon the glass and the greater the lustre of the glass the brighter the silver deposit and hence, the greater the resulting reflective power of the mirror.

Chemical deposits of silver upon glass have not proven satisfactory as a basis for electro silver deposits or copper deposits upon glass, due to the fact that the deposit so applied is not tenacious enough to withstand the chemical action or the density of the electro plating solution which necessarily must be used for thick deposits of either silver or copper.

The adoption of the china decorators' method of burning-in the basic silver surface has proven the most successful method to use for either silver or copper deposits. It is the purpose of this article to explain the methods used in preparing the glass for silver or copper electro deposits; also to give the formulæ for the electro depositing solutions.

Chemical Method of Silvering Glass

With unusual care it is possible to use the chemical method of silvering glass as a basis for silver or copper deposits. The silvering solution should be prepared as follows:

SOLUTION A

Distilled water	5 ounces
Pure silver nitrate crystals	1 ounce

When the silver nitrate has been dissolved add aqua ammonia (26 per cent) until the brownish precipitate that is formed by its addition is just re-dissolved. Then add more distilled water to make up the total of 100 fluid ounces.

SOLUTION B

Distilled water	20 ounces
Grape sugar	2 ounces
Rochelle salts	2 ounces

Dissolve the materials in the water and then add ½ ounce silver nitrate, previously dissolved in 2 ounces of warm distilled water. The solution should be boiled for a half hour, replacing the water lost by evaporation. When the boiling is completed and the solution becomes cool, mix solutions A and B and filter through filter paper.

To use for silvering, the mixed solutions should be flowed over the perfectly clean glass and the solution allowed to remain for 20 to 30 minutes. The glass will then become silvered. The excess solution should then be removed and the silver left to dry. The surface is afterwards washed carefully with distilled water and is ready for the electro plating operation. As previously stated, the chemical deposit of silver does not have sufficient adherence to be plated in the regular normal solution used for either silver or copper plating, so it is advisable to first use a modified copper plating solution to back up the silver deposit first and then finish in the normal solutions to be given.

SOLUTION C

Distilled water	1 gallon
Copper sulphate	1 ounce
Rochelle salts	1¼ ounces
Aqua ammonia (26%)	⅛ ounce

Use with soft sheet copper anodes. Temperature normal. Voltage 2. Amperage or current density two to three amperes per square foot of surface area. The deposit of copper must form slowly and unusual care must be used in handling the glass articles when immersing them in the copper solution. The time of deposit may be from 15 to 30 minutes. The articles should then be removed and washed carefully if the final deposit is to be silver. In order to produce a perfectly adhering deposit of silver to the copper it is advisable to lightly amalgamate the copper surface with mercury. For this purpose the following solution should be used:

SOLUTION D

Water	1 gallon
Sodium cyanide	6 ounces
Yellow oxide of mercury	⅛ ounce

Immerse the copper plated glass articles for a minute until

the copper is uniformly whitened with the mercury, then wash the articles thoroughly in cold water and plate in the regular silver depositing solution.

SOLUTION E

Water	1 gallon
Sodium cyanide (96–98%)	6½ ounces
Silver cyanide (80½%)	5 ounces
Potassium carbonate	2 ounces
Ammonium chloride	⅓ ounce

It is advisable to filter the solution as commercial materials usually contain some insoluble matter. Anodes should consist of fine silver in sheets which should be annealed dead soft. The voltage should not exceed one, and the amperage from 3 to 5 per square foot of surface. The time of deposit will depend upon the thickness of silver deposit required.

As previously stated, the burning-in method of application of the basic silver surface is the most satisfactory surface for electro deposits upon glass whether silver or copper is to be finally deposited.

During the great world war the burning-in method of applying silver as a basis for copper deposits upon Leyden jars used in wireless apparatus was adopted by several firms. The Marconi Company, however, used the copper bronze method of preparing the glass for the electro copper deposit. This method is used extensively in the preparation of non-metallic surfaces of wood and plaster in the well known galvanoplastic method of deposition now extensively used in electro-plating thousands of art reproductions in wood and plaster of paris. The method used by the Marconi Company will be explained later.

Application of Silver by the Burning-in Method

Preparation of the Silver Paint: Grind together with pure spirits of turpentine 1 ounce of fine silver powder and 1 ounce of red oxide of mercury. Use only sufficient turpentine to give a plastic mixture, then add Dresden fat oil to produce a fluid paint which can be applied to the glass without the danger of running. In applying the paint, which should be very thoroughly mixed, use badger or camel's hair brushes. After applying the paint to the glass the articles should be allowed to dry for a length of time in a room heated to not less than 80 degrees F. and free from dust.

The articles are now ready for firing. This operation should be accomplished in a small kiln suitably heated so that the glass can be heated to the melting point of the metallic silver. It is advisable to allow the glass to cool down normally in the kiln before removing as sudden chilling will invariably produce cracks in the glass.

The articles will show a dead white coat of silver. They must then be carefully wired up with soft copper wire about 20 B & S gauge so arranged that several points of contact are made with the silver coating so that in the resulting electro plating operation a uniform current condition will result. The same conditions must be followed in copper plating operations. After the articles are wired they should be immersed in a dilute sodium cyanide solution to remove any oxide or sulphide that may have formed after the firing operation.

SOLUTION F

Water	1 gallon
Sodium cyanide (96–98%)	6 ounces

Immerse the glass articles in the cyanide solution for a moment, then remove and plate direct in silver solution E until the desired thickness of silver is obtained. The burning-in silver method can be used most efficiently in copper plating glass. After the firing of the articles and wiring up, as outlined, followed with the cyanide dip F, wash thoroughly in clean water and then copper plate in either of the following copper solutions:

SOLUTION G

Water	1 gallon
Copper sulphate	1¾ pounds
Pure sulphuric acid	2 ounces
Powdered alum	2 ounces

SOLUTION H

Water 1 gallon, copper sulphate until 16 degrees Baume is reached, then add pure sulphuric acid until 18 degrees Baume, finally add ⅛ ounce of oxalic acid.

Temperature of solution should be normal, or 80 degrees F. Use 1 to 2 volts, and amperage 5 per square foot of surface. Time of deposition according to the thickness of copper deposit desired.

Copper sulphate solutions should be operated with slight agitation. Compressed air conveyed through perforated lead pipes to the solution is the method most commonly used. Continuous filtration by the aid of chemical stoneware pumps and felt filter bags is also being used with very satisfactory results.

The metal content of the copper sulphate solutions are constantly maintained to the normal point by adding the copper sulphate to the solution in small crystalline form in jute bags or bags made up from several thicknesses of cheese cloth.

The Marconi Method

The Marconi method of metalizing Leyden glass jars for wireless work is as follows: The glass is thoroughly cleaned by the aid of alkaline solutions of sodium carbonate and sodium hydroxide or potassium carbonate and potassium hydroxide using from 4 to 8 ounces per gallon of hot water. The alkaline cleansing should be followed up by washing thoroughly in cold water and then the glass articles should be immersed for a moment in a mixture of 2 parts of nitric acid and 8 parts of water. The nitric acid removes any coating that may be found upon the glass. If leaded glass is used and the glass is coated to some extent with a whitish coating due to the lead, then the nitric acid should be replaced with a solution composed of 1 part of hydrofluoric acid and 8 parts of water.

Following the acid cleansing the glass should be thoroughly washed in cold water and dried uniformly by heat. What is termed "platers' copper bronze powder" should now be thoroughly mixed with turpentine copal varnish and then thinned down with turpentine to a fluid paint. The copper bronze mixture should be applied to the glass by an air spray or flowed over the glass. Quite frequently a second thin coating of copper bronze is necessary to completely cover the glass. When the operation is completed the varnish coating should be allowed to dry thoroughly for forty-eight hours. Following the drying operation the glass articles should be immersed in a silver dip so that the copper bronze surface becomes uni-

formly white in tone. The silver dip should be prepared as follows:

Water	1 gallon
Sodium cyanide (96-98%)	1 ounce
Silver cyanide	¼ ounce
Caustic potash	⅛ ounce

The reason for the use of the silver dip is that when the articles are immersed in the regular plating solutions the rate of copper deposit upon the silver can be more readily noted than when the copper bronze surface is left uncoated.

The copper bronze coated glass should be immersed in the silver dip for a moment or two until the copper becomes whitened, then wash the glass again in clean cold water and electro plate in either of the copper sulphate solutions G or H.

The solutions and methods given in this article are in constant daily commercial use.

Foremen Training in the Glass Industry

By B. M. NUSSBAUM*

Foremen training is a comparatively new subject, not only in the literature of the glass industry but of all industry. Training courses for beginners and operatives have been fairly common for many years. And of course the old apprentice system, modified to meet modern conditions, has always been a foremost factor in providing skilled and semi-skilled workmen trained on the job. But very little thought was given to the special training of foremen. The prevailing idea was that every even-tempered man who proved to be a good workman would make a good foreman.

It was during the period of the war, when factories had to work under pressure, often under emergency conditions, sometimes shorthanded or with green workers, that the vital place which foremanship occupies in production was demonstrated. It was shown then that a foreman has to have more than technical skill, has to be more than merely the star workman in his department. He has also to be a skilled manager and leader of men, if he is to get the full confidence and co-operation of those under him. Moreover, he has to know the organization and general work of the plant, the basic principles underlying production, if he is to co-operate with his brother foremen and the management as a whole.

Thus the idea of training foremen in the special functions and requirements of foremanship was born. Inquiries into the foremanship problem were made, studies were carried on at various plants, and several plans of foremen training were devised and tried out. With the reaction which followed the war, many plants found foremen training one of the most important aids in their efforts to restore business to a profit basis. In several cases, during the depth of the industrial depression, while the plant was operating part time, the foremen were put through a course of training in basic principles and modern methods to prepare them for better handling of their departments when production became normal again.

There are, as I have suggested above, several plans of foremen training. There are lecture courses, conference courses, company courses, and many variations and developments of these. My experience is with a standardized course which has been used in such well known concerns of the glass industry as Ball Brothers of Muncie, Indiana, Corning Glass Works of Corning, New York, the San Francisco plant of the Illinois-Pacific Glass Company, and the Milwaukee plant of the Pittsburgh Plate Glass Company. The same course has been used with equally satisfactory results in other industries as well, and in all more than 30,000 foremen in more than 600 industrial plants of the United States and Canada have passed through its training. I mention this only in passing; the discussion in this article will be confined to the experience in plants of the glass industry.

"What foremen in the glass industry need," said the manager of an important plant, "is to broaden their personalities and their knowledge of industry. Our foremen are already skilled. In an old industry like the glass industry you find very frequently three generations working together in the same plant, a grandfather who is a veteran in the service, a son who is in the prime of his craftsmanship, and a grandson who is just getting initiated into the intricacies of glass making. Skill is a matter of pride. It is taught and handed along from generation to generation, and the result is that you get men, both workers and foremen, who are real experts, specialists in the true sense of that word. But by the very fact of their specialization, they are too often narrow. They have the habit of thinking in terms of the department instead of in terms of the plant. And skill is so uppermost in their minds that it pushes out everything else. The result is that you get a foreman who is a mighty skilled man, but not necessarily a leader of his men. Too often he is grouchy and overbearing, or rather ineffective when it comes to discipline. He doesn't know how to manage men or how to co-operate whole-heartedly with the teamwork of the company. In other words, he is one-sided. What we need is foremanship that is all-round in its development, that includes managerial ability and co-operating ability as well as the technical ability which foremen already have."

All-Round Development

The training plan treated in this article is based on this idea of giving the foremen of a plant all-round development. Accordingly, in its selection of material for study and teaching, it concentrates on those subjects of which the average foreman knows little and which at the same time are absolutely essential to successful handling of a department. These subjects were not chosen offhand, but represent a careful survey of many representative industrial plants with a view to eliminating what the foreman already knows and focussing all attention on the matters of essential practical value to his daily work. One thing found out in this survey was the average foreman's prevailing ignorance of principles.

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A foreman will do a certain thing a certain way, because it has always been done that way, or because he was taught by his predecessor to do it that way, or because the orders of the management are to do it that way. In far too few cases was it found that the foreman had any well-reasoned knowledge of why it was so done. An important element of the training material, therefore, was the basic principles of industry—such principles as specialization, standardization, elimination of waste, utilization of resources, and the like.

Handling Men

A second thing discovered in this inquiry was the average foreman's ignorance of the principles of handling men. Here and there a foreman was found who seemed to be a born leader, or by his own efforts had developed himself in leadership qualities. The great majority of department heads were seriously lacking in this ability. Thus another important element of the teaching material was indicated.

It was not enough to adapt the material to the foreman's needs and limitations. Adaptation of the method of training to the foreman type was also necessary, and this was accomplished by the use of four factors: (1) Textbooks giving the basic study material; (2) lectures by qualified experts to give local application to the teaching of the study-units; (3) problems calling for written solution by the foremen-students, thus giving them practice in applying the principles and methods to actual industrial situations, and also giving the instructors a means of checking up their mastery of the course; (4) group conferences for question and answer, for discussion, and to clear up points raised in the reading or lectures.

Much might be written about each of these factors in the training. The textbooks, for example, were not simply a set of selected books on mechanics, management, economics, psychology, and so on, but were specially written texts. To be sure, they contained practical discussions of the subjects just named, though they were not called by any "highbrow" names; but the subjects were so presented, by concrete examples and illustrations, and the style was so simple and readable, that the foremen in most cases found the books not only instructive, but highly interesting and actually entertaining. When the idea of having textbooks and requiring the foremen to study them was first proposed, some executives said it was an impossible scheme. "Foremen are grown-up men, department heads, and all that," they said, "and you can't expect them to go back to school and study." Perhaps not, under ordinary conditions, but with specially prepared texts and under the stimulus of a lecture based on each textbook and a problem also based on each textbook, reinforced by a group conference on each, the records show that foremen do study. The average percentage of completion for all foremen groups is above 80 per cent, and in many plants this figure has been passed. In the Corning Glass Works, for example, where 244 men enrolled, 232 completed all the requirements of the three months training—a completion record of 95 per cent.

The Response

Perhaps the best way of conveying some impression of the actual response of foremen and other plant executives to a proposition of this kind is to give an account from an observer on the ground. The following is quoted from *Cullet*, the monthly plant magazine of the Corning Glass Works, in reporting the inauguration of a foremen's training course in that plant:

"Notices were sent out inviting all foremen particularly, and any others who might be interested, to meet in the small lunchroom at 5:30 p. m. on December 15, at which time Mr. Goodwin would explain what the course consisted of and the method of conducting it. The small lunchroom seats about 80 people comfortably, and it was believed the accommodations would be ample; but by the time of the meeting the chairs and every available foot of standing room were taken and the approaches crowded with a good-natured crowd clamoring for admittance which is only equalled by the crowd before the ticket window when "Bosco eats 'em alive." No one had expected any such response and it was evident we had to tear down our barns and build greater, so a self-appointed committee of a couple of dozen adjourned to the main dining hall, hastily stacked tables out of the way and cleared the floor for action. At the command 'Take up thy bed and walk,' everyone grabbed his chair and hiked. The large room was taxed to its utmost capacity, a total of about 250 being in attendance.

"Briefly, the proposition was this: The course is comprised of six units, each unit consisting of about 140 pages of text, and each to be completed in two weeks. At the completion of each unit a problem based on the text is to be solved and a lecture interpretative of the text is delivered. This brings one lecture every other week and on the alternate weeks a group meeting is held under the direction of the local leaders in which a free-for-all discussion of the text and pertinent problems is held. Accompanying the course and preliminary to it is a self-analysis chart, solely for the benefit of the victim, which every fellow is supposed to fill out in the solitude of his chamber with tears and fumbling.

"In order to place the course within the reach of everyone, the company pays half the cost, the members paying the other half either in one amount or in monthly or weekly instalments. At the completion of the course, all who see it through to a successful finish, which is evidenced by earning the diploma, have their money refunded.

"At the conclusion of Mr. Goodwin's remarks, the general sentiment expressed was, 'When do we sign?' According to our best recollections, Charley Gridley was the first to get his name on the roll, and the rest came tumbling after. In all, some 245 persons, from the president to apprentices, with a long list in between, have subscribed; and were it not for the fact that the course is now well under way and new entrants would therefore be seriously handicapped, the process of enrolment might still go merrily on. It is, therefore, thought best to close the roll for this time, and after the completion of this course, some other action based on the requirements of the case may possibly be taken."

Obtaining Best Results

It is my observation that the best results in foremen training have been obtained when the higher executives, as in the Corning Glass Works group, joined with the foremen in the training. It is also a wise policy, as in the case here, to take in operatives and others of the rank and file who

may be promising material for the foremanship. No stronger evidence of the value of this training need be cited than the evidence already quoted—of a 95 per cent completion. In any plant, if so large a number of the supervisory force can be brought to study with interest and real zeal such subjects as teamwork, team leadership, handling men, handling equipment, the use of production records, industrial organization, and principles and policies of management, the result cannot but be of practical value to that plant.

"It is my observation," said C. S. Izant, works manager of the Corning Glass Works, in reporting the results of the training, "that some of the fences between departments have developed large gaps and men are working more harmoniously. I think that perhaps the greatest single good which we have derived from the course is the fact that our men have come to realize that business is more a matter of harmonious human relationships than it is of facts and figures, and that in the personal contact which has come as a result of studying together they have come to be more of one mind than when they were working as individuals."

The foreman of one of the departments of the Corning Glass Works sent in this report at the end of his course: "I have recently practically doubled the production of a machine." An engineer in the same company made this statement: "The co-operation between the various departments has been greatly improved, which is of considerable value; also the foremen seem to have a much better idea of their duties and responsibilities."

In the large fruit-jar plant of Ball Brothers Glass Manufacturing Company, at Muncie, Ind., 45 men of the supervisory force were enrolled in this same course of training. An interesting picture of the results accomplished there is given in this report from H. L. Craven, assistant purchasing agent:

"We have met together as a group with the single aim of bettering ourselves, our departments, and our firm. This aim has involved our learning from each other and of hearing the other fellow's side of the story. It has resulted in a better and more mutual understanding of conditions as a whole, and I believe every one of us has profited by it. The course has touched on the more delicate situations, such as jealousies and frictions between foremen, and has prompted discussion of these things and led to understandings which probably would not have been discussed for fear of picking a scab off an old sore."

The training experience in the Pittsburgh Plate Glass Company was with a small group in a composite class representing several factories meeting in the Milwaukee Y. M. C. A. One of the glass foremen gave this estimate of the results at the end of his course: "I know that my department is running better." Another foreman in the same company said: "The course has proved of value to the company because it brought the foremen closer. It taught co-operation and harmony between departments. It taught the foremen how to handle the help with more tact and diplomacy."

Many of these results may seem intangible. Increased harmony between department heads, co-operation, bettered teamwork, better handling of men, developed interest, quickened responsibility, closer relations between the foremen and the management—these are some of the results. Are not these the very things that make for reduced spoilage, more economical operation, bettered production?

Abrasives and Polishing Powders for Glass*

By JAMES WEIR FRENCH, D. Sc., F. Inst. P.

Abrasives are used by the optician for the reduction of the raw glass to the required form, and polishing media for the production of the final regular surface.

Glass is a vitreous substance, so close grained that no

FIG. 1.—ETCHED PERCUSSION CONE CRACKS (x 42).

structure is observable. It is brittle at ordinary temperatures and its conchoidal fracture is a characteristic and fortunate feature that permits of the glass being worked to the desired form.

Prehistoric man solved the problem of abrading such substances. His flint implements were produced by a process of flaking identical in character to that employed by the manufacturing optician of today.

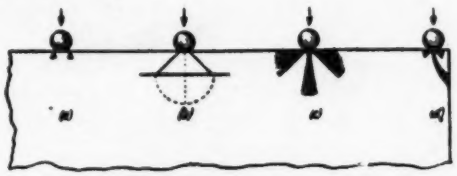


FIG. 2.—DIAGRAM OF FRACTURE OF GLASS

When the principles of abrasion are known, it is possible to predict with some certainty not only the abrasive qualities of a material, but also the conditions of working.

As a preliminary it is vital then to understand what is the action of an abrasive.

Suppose the pressure of a steel ball is applied to the surface of a polished glass cube, and the strains introduced are observed by means of a polariscope. At a very early stage a fine surface crack encircling the area of contact will appear.

*Trans. Faraday Society, Vol XVIII, Oct. 1922, Part 1.

Some of these surface cracks emphasized by etching are shown in Fig. 1. Remarkably small forces serve to rupture the surface layer. If talcous powder be smeared upon the surface, the gentle application by hand of a blunt point, even of wood, will suffice to rupture the surface. The forces are small compared with those suggested by calculation from the physical constants of glass.

In Fig. 2 the surface crack is indicated in elevation at (*a*). If the pressure be increased a cone fracture will be formed. This cone fracture cannot be continued indefinitely as the glass under the ball collapses, and the cone at once spreads at its base as indicated in Fig. 2 (*b*).

In the abrasion of glass it is necessary to avoid the production of such cone fractures which would result from any

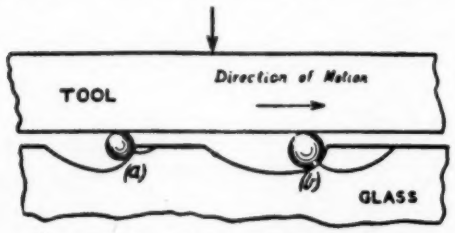


FIG. 3.—DIAGRAM OF ABRASION

pounding action of the grinding tool, and it is remarkable that in the common process of abrasion, notwithstanding the multitude of impacts that occur, the production of a cone fracture is rare.

Under polarized light the distribution of the strain caused by the pressure of the ball will be symmetrical, as indicated at Fig. 2 (*c*). Suppose now the ball is pressed upon the edge of the block; the direction of the maximum strain will be deviated towards the side, and a further increase of the pressure will give rise to a true conchoidal fracture without any appearance of the cone fracture as at (*d*).

In the process of abrasion, say with steel shot as indicated in Fig. 3, the loaded tool in moving parallel to the surface of the glass drives the grains of abrasive against the edges of the concavities with the production of true conchoidal splinters. Thus a translational movement of the tool that wedges the grains against the glass edges as distinct from a vertical pounding action is an essential condition.

It is not difficult to foresee that, if the grains are of a suitable kind, the rate of abrasion will depend upon——

(1) The size of the grains. Small grains as at (*a*), Fig. 3, will strike nearer the edge and produce smaller splinters than large grains that strike deeper, as at (*b*).

(2) The force of impact which depends upon the load on the tool, its momentum, its speed of translation, and its grip on the grains.

(3) The number of impacts per unit time. The greater the speed, the more frequently will each grain be brought into action, and an abrasive, each grain of which presents several points, will be more rapid than a plain spherical grain.

That the rate of abrasion is proportional to the load on the tool and also to the relative speed of translation, has been established as the result of properly regulated experiments in which fresh abrasive was continuously applied and clogging prevented.

It is common experience that the action is more rapid the coarser the grain is, and that soft cast iron or brass tools are more effective than hard steel ones that do not grip the grains so well.

A lamellar grain that distributes the pressure over its surface instead of concentrating it at points will prove unsuitable. Schistose materials have little abrasive power.

Several typical abrasives are illustrated in Fig. 4. Diamond splinters, Fig. 4 (*a*), are very similar to carborundum, Fig. 4 (*b*), the former, however, being the harder and more effective. They break down into fragments that present a large number of hard corners. Crown glass and carborundum are of practically the same average specific gravity and to separate them by levigation is impracticable. It is found, however, that quite a large admixture of glass, even up to 60 per cent, gives good results, and indeed is advantageous, as when no glass is present, greater care in the use of the carborundum is necessary, especially when the loads and speeds are high.

Emery, indicated at Fig. 4 (*c*), is natural alumina with impurities that increase the liability to disintegration. Clogging, therefore, occurs more readily and the abrasive is said to lose its cut. It is not so effective as carborundum.

Rounded grains of sand are indicated in Fig. 4 (*d*). This material breaks down readily and clogs, and as an abrasive it is not nearly so effective, although its cheapness may in some cases justify its use.

The grading of abrasives by opticians is very frequently done by the ancient process of settling and decanting or by settling in a steady stream of water. In the earlier stages of the latter method sieves may be employed but there is

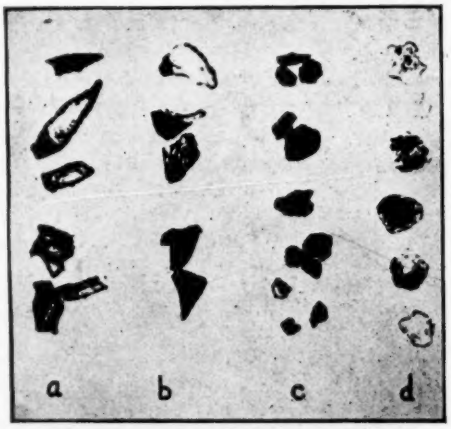


FIG. 4.—TYPICAL ABRASIVES.

none available that is capable of dealing with the finest grades. By surface flotation there can be obtained a grade of carborundum sufficiently fine to polish glass almost as well as can be done by some of the common polishing media. Carborundum as a polishing medium is not recommended; the circumstance is only referred to as being suggestive of the polishing action.

Reference has been made so far only to loose abrasives; it is necessary to refer briefly to the use of grinding wheels.

Essentially there is no difference in the action of a grain on the surface of a wheel and a loose grain acted upon by a surface tool. Carborundum and other types of grinding wheels with a copious supply of water are frequently used, but as regards the rate of abrasion they cannot compete with a loose abrasive, since in the case of the wheel the action takes place along a line contact, whereas in the case of the surface tool the whole of the surface of the glass is being acted upon all the time. Up to the present it has not been found practicable to use surface grinding wheels, owing to the difficulty of obtaining the requisite quality of surface and of maintaining an adequate supply of cooling water.

It will be of interest now to consider the action of polishing as distinct from that of abrasion. If an abraded surface is examined it will be seen that the ridges are rounded. Under the microscope these ridges have a characteristic sea-green color that appears to be independent of the nature of the glass. There can be little doubt that the surface molecules

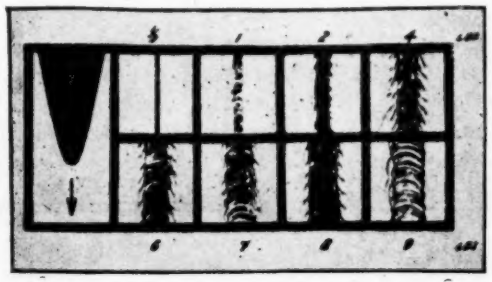


FIG. 5.—ETCHED PERCUSSION CRACKS.

have been so disturbed that they have re-arranged themselves, just as the more mobile surface molecules of water may re-arrange themselves to form a molecularly regular surface.

Sir Isaac Newton thought that the difference between a polished surface and a rough-ground surface was only one of degree. His opinion was generally concurred in, although Robert Hooke appears to have been doubtful upon the subject. The late Lord Rayleigh first drew attention to the pool-like character of small polished areas on the surface of semi-polished ground glass and to the fact that there are no transition stages. It is astonishing that so obvious an appearance under the microscope had not been previously remarked upon. Sir George Beilby, particularly in connection with the polished surface layer of metals, has stated that surface tension forces largely determine the flow of the surface layer molecules when disturbed by the mechanical action of the polisher.

So far as glass is concerned, the term "polish" is somewhat indefinite. In the fracture of a piece of glass the surface molecules rearrange themselves just as they do when the material is acted upon mechanically, or by heat, as in fire-glazing, or chemically, as in etching with hydrofluoric acid. It is almost impossible to obtain a piece of glass that has not a polish surface, although the surface in question may be quite irregular. If a block of glass is ruptured with great suddenness, the surface may be matt over considerable areas, but under the microscope this is quite evidently due to the formation of minute conchoidal cavities, the individual surfaces of which are molecularly regular. A ground-glass surface consists of small depressions whose surfaces are polished. In the case of an optically worked piece of glass, the surface is not only polished but is free from depressions. Therefore the process of polishing involves a continuation, but in a different manner, of the abrasion and a reduction of the level of the protuberances until the bottoms of the cavities have been reached. From the practical point of view it is very important that the cavities should be of uniform depth, because, if there exist some cavities deeper than the others, they can only be eliminated by a slow process of reducing the whole surface to the depth of the deepest cavities. The importance of uniformity in the final process of abrasion is well recognized by the optical manufacturer.

In the process of polishing it is essential that the amorphous surface layer of molecules should be ploughed away and that the forces applied to the glass through the intermediary of the grains of the polishing medium should not be so great as to form conchoidal splinters. Therefore, instead of a hard cast-iron tool, a softer one, say of pitch, wax, hard felt, or paper, may be employed with an abrasive medium of an extremely fine character that will form spongy accretions. Of these media the most frequently employed, and indeed the best, is ferric oxide, that is, rouge. The individual particles of levigated rouge are ultra-microscopic; when worked the particles appear to gather snowball-fashion into spongy balls which under the action of the tool plough

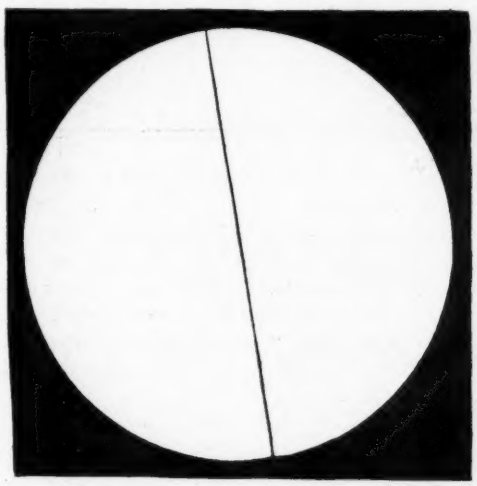


FIG. 6.—SLEEK (x 230).

away the surface of the glass. To observe these marks is not easy but with suitable media they can in extreme cases be made visible under the microscope. By means of the abrasive, or, as it is commonly called, the polishing medium, the prominences are reduced until the bottoms of the cavities are reached. But when this stage is attained it is desirable to avoid the further production of such grooves and it is no longer necessary to remove material. That material is removed during the stage described can easily be demonstrated by micrometer measurements or by weighing, although in the latter case the results may be vitiated by the formation of minute chips on the edge of the glass.

The final polishing is best effected without the use of any medium. It is customary, therefore, to employ in the final

stage only water and the action is continued until this water just dries up. The pitch surface is then brought into very close contact, although not absolute contact, as there must always be a film of liquid, and under the intense mechanical action a final truly regular surface is obtained.

The material most commonly used as a polishing abrasive is, as above stated, ferric oxide, *i.e.* rouge. The precipitated hydrate does not give good results as its consistency is gelatinous; it does not form the spongy particles already referred to. Black oxide of iron is the principal ingredient of the trade article Glassite. The absence of the appearance of cleanliness in its use is a disadvantage. The earlier opticians made extensive use of putty powder, *i.e.* tin oxide, which gives excellent results, although not superior to rouge; tin oxide, however, is prohibited in the industry on account of its poisonous nature. Oxide of alumina is sometimes used, although it is not so easily levigated as rouge; this material is the principal ingredient of the trade article Diamantine. Manganese dioxide is also an excellent medium that is, however, not frequently used, owing to its blackness; it is very difficult to remove it from the pores of the skin.

It has sometimes been stated that the best polishing media are oxides. As previously stated, however, glass can be polished with very fine carborundum, *i.e.* silicon carbide, which has been specially treated with hydrofluoric acid and when using oil as a medium. Excellent results can also be obtained from the use of carbon and many other substances, provided they can be brought into the required physical condition.

The conclusion from the above remarks is that the polishing action is, broadly speaking, a physical, not a chemical one.

Reference has been made to the amorphous surface layer. It has often been remarked that when a polished surface is etched, innumerable scratches reappear and the conclusion has been arrived at that these scratches are original ones that have been covered by the surface layer. This subject has received great attention from Sir George Beilby, in most of whose experiments, however, metals have been used. Now, whatever may be the case in metals, it should not be too readily accepted in the case of glass that the scratches appear because a covering surface layer has been removed. Microscopic examination shows that the lines that appear are in the great majority of cases series of minute percussion cracks of the type represented highly magnified in Fig. 5, or fine ploughed grooves of the type indicated in Fig. 6. If any hard substance is gently drawn over a polished surface, percussion cracks will be formed. They are quite invisible until the etching vapor strikes the surface of the glass, when the scratches flash instantly into view.

The Laboratory

By J. B. KRAK

Notes on Combustion

There are two sources of heat utilized at the present time in the glass industry—chemical action and electric current. The latter is always produced either by chemical action, as in the case of a dynamo driven by a steam or gas engine, or by mechanical energy derived from water power.

Chemical change and heat are closely and definitely related. Chemical combination of two substances is usually accompanied by the formation of heat. A familiar example of this fact is the slaking of lime. The union of burnt lime and water produces a large amount of heat, sufficient to turn part of the added water into steam. If rain is allowed to leak in upon lime, stored in a wooden building, there is great danger of fire.

A similar action takes place when fuel is burned. Burning may be defined as a rapid combination of the combustible part of the fuel with the oxygen of the air, accompanied by the formation of heat and flame. The combustible parts of fuel are carbon and hydrogen. When the temperature of the fuel is raised to the kindling point, combination with oxygen takes place, with the formation of the oxide(s) of carbon and water.

Perfect combustion is obtained when the combustible parts of fuel unite with the greatest possible amount of oxygen. Each combustible element combines with oxygen in certain definite proportions and generates a definite amount of heat. This is termed the calorific value of the substance and is measured in British thermal units, which may be defined as the amount of heat necessary to raise the temperature of a pound of water one degree Fahrenheit. In countries where the metric system is used the unit of heat is the calorie, which is the amount of heat required to raise the temperature of a kilogram of water one degree Centigrade.

Carbon can combine with oxygen in two ways. It can form carbon monoxide, when one part of carbon unites with one part of oxygen. Or it can combine with two parts of oxygen and form carbon dioxide. Ordinary chemical equations usually do not express the formation of heat. To represent heat changes, the number of B.t.u.'s involved are placed after the equation, thus:

$$\underset{\text{carbon}}{C} + \underset{\text{oxygen}}{O} = \underset{\text{carbon monoxide}}{CO} + 4{,}450 \text{ B.t.u.}$$

$$\underset{\text{carbon}}{C} + \underset{\text{oxygen}}{2O} = \underset{\text{carbon dioxide}}{CO_2} + 14{,}600 \text{ B.t.u.}$$

$$\underset{\text{hydrogen}}{2H} + \underset{\text{oxygen}}{O} = \underset{\text{water (steam)}}{H_2O} + 62{,}000 \text{ B.t.u.}$$

It follows that if one pound of carbon unites with oxygen to form carbon dioxide, there are 10,150 B.t.u. more generated than if carbon monoxide is formed.

Air Required for Combustion

One pound of carbon unites with 1⅓ pounds of oxygen to form carbon monoxide, and with 2⅔ pounds of oxygen to form carbon dioxide. Air contains about 80 per cent nitrogen and 20 per cent oxygen by volume, but by weight 4.32 pounds of air is required to furnish one pound of oxygen. Therefore

one pound of carbon requires $4.32 \times 2\frac{2}{3} = 11.5$ pounds of air for complete combustion, forming 12.5 pounds of flue gas.

A pound of carbon may unite with $1\frac{1}{3}$ pounds of oxygen to form carbon monoxide and yield 4,450 B.t.u.; in its further conversion to carbon dioxide it unites with an additional $1\frac{1}{3}$ pound of oxygen and evolves the remaining 10,150 B.t.u.

It is obvious that the maximum amount of heat would be obtained if just enough air were supplied to completely oxidize all combustible elements. In practice, however, it is impossible to obtain perfect combustion with the theoretical amount of air. The reason for this is that it is not possible to bring each particle of oxygen in the air in contact with the fuel, due to the dilution of the oxygen by nitrogen. An excess of air is always required, its amount depending on the nature of the fuel and the method of combustion. When gas or oil are burned less excess of air is needed than when coal is burned on a grate. Experience has proven that coal requires about 50 per cent more than the theoretical amount of air for complete combustion. Bituminous coal and anthracite require about 15 pounds of air for each pound of fuel. Natural gas, producer gas and fuel oil give the best results with about 10 per cent excess air. This, however, is exceptionally good practice and is not found in many plants. From 15 to 20 per cent excess air would be a good practical percentage.

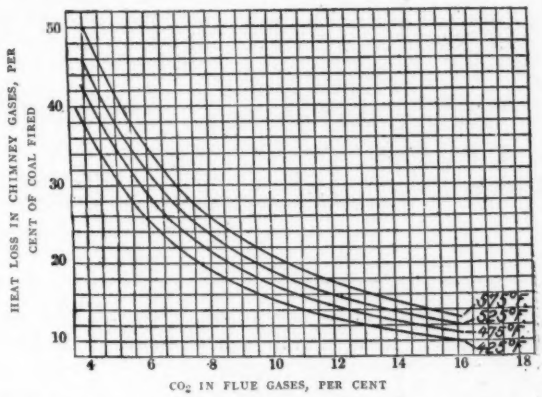
If less air is supplied there may be loss of heat due to the formation of carbon monoxide, which may either burn in the stack without useful effect, or escape unburned. By far the greatest chance of loss, however, is the tendency to admit an oversupply of air. The excess air takes no part in the combustion process and carries away heat through the stack. It lowers the furnace temperature due to its diluting effect on the hot gases and the capacity of the furnace is reduced correspondingly. Excess air also means a larger volume of hot gases flowing through the furnace per unit of fuel consumed and hence a higher velocity of gas flow and consequently less time to impart the heat to the batch.

Power House Practice

The relation between the amounts of fuel and air which yield the maximum quantity of heat has been carefully worked out for conditions prevailing in power house practice. The following applies to boiler furnaces only, but the same general principles govern combustion under all circumstances.

If all the oxygen entering the furnace were used in combustion, the analysis of the chimney gases would show about 81.5 per cent of nitrogen and 18 per cent of carbon dioxide by volume. The percentage of carbon dioxide would not be as high as the percentage of oxygen in the air admitted since some of the oxygen combines with the hydrogen present in the fuel, either as free hydrogen (producer gas), as methane (natural gas) or in combination with carbon of the oil or coal as more complex bodies. This hydrogen forms water vapor, which is condensed and does not appear in the analysis of the flue gases.

If the proper proportion between fuel and air supply is maintained the percentage of carbon dioxide is near the theoretically possible amount. If a large amount of excess air is admitted the carbon dioxide will be diluted and analyze low. The amount of carbon dioxide therefore is an indication of the air supply and of the efficiency of the method of heating. There are other factors which have a bearing on the amount of heat lost through the chimney. It



is evident that the higher the temperature of the flue gases, the greater the loss. The relations between the percentage of carbon dioxide in flue gas, the temperature and the heat loss is represented in the chart in which the horizontal distances represent the percentages of carbon dioxide and the vertical distances the heat losses. Each of the curves give the loss for a temperature between the flue gas and the air entering the furnace, as indicated by the figures at the right of each curve. They are computed for coal having 82 per cent of carbon and a heat value of 13,500 B.t.u.[1]

To control combustion it is advisable to analyze the flue gases frequently. The saving in fuel thus effected may run into thousands of dollars. The quantities determined are the relative proportions by volume of carbon dioxide, oxygen and carbon monoxide, the determinations being made in this order.[2]

Glass House Conditions

There is no such simple relation between the amounts of carbon dioxide and heating efficiency in the case of glass furnaces. This is due to the fact that the decomposition of the soda ash and limestone of the batch yield large quantities of carbon dioxide, or sulphur dioxide if salt cake is used. A tank furnace, which receives quantities of new batch periodically, will show high amounts of carbon dioxide in the flue gases soon after each filling of batch.

While it is true that control of the fuel and air supply as indicated by flue gas analyses is helpful in attaining efficiency, there are many other factors which influence the final result. Among them may be mentioned the temperature of the fuel and the air supply at the point of combination, the velocity of the combustion which in turn is dependent on the nature of the fuel, the design of the burners and of the combustion chamber. Producer gas of 150 B.t.u. can produce the same temperature as natural gas of 1,100 B.t.u., provided it is burned in a suitably designed furnace. The losses which occur in combustion are comparatively unimportant in comparison with the enormous heat losses occurring in the application and utilization of heat in the glass industry.

[1] Bulletin 97. Bureau of Mines.
[2] For method of analysis consult this Journal, Vol. 3, pp. 250-251 (December, 1922).
[3] U. S. Patent No. 1,304,208. J. Ind. & Eng. Chem., Vol. 12, p. 359.

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CLASSIFIED BUYERS' GUIDE, PAGE 14

"Remember this: They who will not be counseled cannot be helped. If you will not listen to Reason she will rap your Knuckles."—BENJAMIN FRANKLIN.

Manufacturers and Financiers

The disadvantages usually associated with modern industrialism are perhaps less noticeable in glass manufacturing than in most other lines of industry. This may be due in a large measure to the fact that the leading men of the American glass industry are glass makers before they are financiers. This attitude was strikingly illustrated by an expression coming from one of the most successful members of the younger generation of glass makers, when he said: "I am more interested in making the finest glass in the best equipped factory, than in making a fortune."

The control of many glass factories has passed from father to son, in some cases through several succeeding generations, each having learned the industry from the ground up, and making the acquisition of knowledge of their craft their life-work and their dominating ambition. Some of the most prominent glass makers of the present day started their careers as boys in the glass house, with no other capital than their native ability. There still remains in many factories that intimate acquaintance between employer and employee which is so important in maintaining happy relations and which accounts to some extent for the absence of strikes and for a sense of loyalty among the workers which has unhappily disappeared largely in many of the country's most important industries.

It is fortunate that the controlling interest in the large organizations which have developed in the glass industry during the past quarter of a century has remained in the hands of glass makers, and has not passed to those who merely furnished the capital to finance these enterprises, without having an adequate understanding of the craft. There is no lack of evidence to prove that when financiers, *per se*, become the directing influence in manufacturing concerns, there develops a tendency towards stagnation rather than progress. There may be larger disbursements to the stockholders at first, but dividends are not always an indication of permanent growth. Unless financial leaders are willing and able to become manufacturers, with all that the word implies, no amount of that power usually referred to as "executive ability" will save them from serious blunders. Without a full understanding of the industry in which they have obtained a leading interest, there can be no all 'round development.

Absentee ownership exists in the glass industry little or none. As long as present conditions persist a normal, healthy growth of glass manufacturing may be anticipated with confidence.

A Study of Ball Clays

Technologic Paper No. 227 just issued by the Bureau of Standards is a study by H. H. Sortwell, associate ceramic engineer, of the six American and fifteen English ball clays used in the largest quantities. From the results of the work done a classification of clays has been drawn in which an attempt has been made to separate the clays into groups of predominating types.

One of the conclusions drawn from the tests made is that in the event of a scarcity of English clays it would be possible to employ domestic clays exclusively in ceramics.

Technical Consultation Service

THE GLASS INDUSTRY invites its readers to refer to this department any problems with which they may be confronted pertaining to raw materials, glass technology, laboratory and factory practice. While making no pretensions to the possession of unbounded knowledge or infallibility THE GLASS INDUSTRY is ready to assist its readers to the best of its ability in solving their problems. Readers who can offer better suggestions are invited to submit them.

Questions should be submitted in writing and will be answered by mail as promptly as possible. The sources of all inquiries will be held in strict confidence.

Question 43. Sand for Glass Making.—Kindly inform us whether the three grades of sand of which analyses are enclosed are suitable for making glass.

WHITE SAND

Ignition Loss—.30 per cent

Silica	98.28
Alumina	.94
Iron oxide	.09
Calcium oxide	.50
Magnesium oxide	trace
Sodium and Potassium oxide	trace

YELLOW SAND

Ignition Loss—.56 per cent

Silica	97.60
Alumina	1.48
Iron oxide	.33
Calcium oxide	trace
Magnesium oxide	trace
Sodium and Potassium oxide	trace

RED SAND

Ignition Loss—.78 per cent

Silica	96.42
Alumina oxide	1.42
Iron oxide	1.22
Calcium oxide	trace
Magnesium oxide	trace
Sodium and Potassium oxide	trace

Answer.—The sample marked "white sand" is suitable for the finest grade of glassware, with the possible exception of some grades of optical glass which require a sand free from alumina.

The sample marked "yellow sand" is suitable for plate or window glass, all grades of bottles and for common glassware used in the household. It is not low enough in iron oxide to be used for high grade cut glass.

The "red sand" can only be recommended for the manufacture of green and brown bottles.

The most important factor in judging a glass sand is the iron content, since iron causes the green color of glass. Alumina up to 1½ per cent is distinctly beneficial, but a larger percentage is a disadvantage, since it may caue a permature "setting" of the molten glass, which makes it difficult to work.

When more than ¾ of one per cent of iron oxide is present, sand is not suitable for window or plate glass, and if the percentage is as high as 1¼ per cent, it can only be used for common bottles.

The majority of glass sands contain titanium, sometimes as much as 0.8 per cent. Since many analysts do not make separate estimations of titanium they report it as alumina, which, of course, may lead to erroneous conclusions. The effect of titanium on the color of glass has not received much attention so far. The writer has found the colorimetric method as worked out by Weller, a very convenient and accurate procedure. This method is described on page 155-163 of Bulletin No. 700, United States Geological Survey.—J. B. K.

Question 44. Polishing Cut Glass.—We are confronted with a problem of polishing cut glass and would like to obtain some information. We are cutting electric light shades which are sand blasted outside but are unable to get the desired results with the use of the cork wheel and pumice stone. We have also tried red rouge. Will you advise if there is a method of polishing these shades with acid?

Answer.—Zinc oxide and tin oxide are used to some extent in place of rouge to polish glass. Chromic oxide and manganese dioxide are also used. The powders should be extremely fine and a good polish can be obtained by using a stiff bristle brush.

If it is desired to use hydrofluoric acid for polishing, the glass should be covered with a protective coating which is removed wherever the surface is to be polished. The object is then put in a bath containing the following solution:

Acid potassium fluoride	500 parts
Hydrochloric acid	250 "
Water	1,000 "

Acid polishing is much more expensive than using the cork wheel and an abrasive.—J. B. K.

Question 45. Suitability of Certain Lime for Glass-Making.—We have had another analysis made of our hydrated lime and enclose the revised report. We should like to know whether or not the analysis shows this lime to be of suitable quality for the manufacture of good glass.

	Per Cent
Lime (CaO)	73.06
Magnesia (MgO)	0.52
Iron Oxide (Fe_2O_3)	0.09
Alumina (Al_2O_3)	0.33
Silica (SiO_2)	0.14
Phosphoric acid (P_2O_5)	1.07
Carbon dioxide (CO_2)	2.90
Water of composition and moisture	22.10
	100.21

Answer.—The analysis shows the lime to be of good quality for ordinary glassware. With good raw materials, cheap and high grade fuel and an extensive market, as described by you, we know of no reason why your enterprise should not be a substantial success if properly managed and carefully supervised. We personally know of several small glass factories, under conditions less favorable than yours, which have paid their stockholders dividends year after year. All of them were conservatively managed and improvements financed from profits rather than through the issue of bonds.—J. B. K.

Question 46. Electro Deposition of Copper and Silver on Glass.—I have been a subscriber to THE GLASS INDUSTRY for two years and have most of the magazines for that period.

I have some work that requires plating of a silver and copper deposit on glass articles. I would appreciate any information you could give me on how to accomplish this.

Answer.—An article on the subject is published elsewhere in this issue of THE GLASS INDUSTRY.

New Books

WHY MANUFACTURERS LOSE MONEY. By Robert Grimshaw. 163 pages, 8 x 5 in. Published by D. Van Nostrand Company, New York. Price $2.00.

A discussion of the many reasons why manufacturers either actually lose money, or make less profit than they should is a task which can only be taken up by one who has a thorough practical knowledge, not only of industry in all its phases, but also of its financial and commercial problems. This requirement is obviously impossible of fulfillment in the present day of gigantic industrial development. It follows therefore that the presentation of the subject necessarily is one-sided and is apt to contain repetitions. Notwithstanding these unavoidable limitations, which the author has by no means escaped, he has succeeded in writing a thoroughly readable book, containing interesting views and many valuable suggestions.

LIQUID FUEL AND ITS APPARATUS, by Wm. H. Booth, Second Edition. E. P. Dutton and Company, New York. 308 pp. 6 x 5½ in. Price, $4.00.

In this volume the author describes the practice of oil burning as applied to marine engineering locomotive practice and devotes a chapter each to American and English stationary practice with liquid fuel. The first six chapters describe the geology, chemistry and physics of oil. Of especial interest to glass manufacturers are the various types of burners, the question of air and steam atomization and the storage and distribution of liquid fuel.

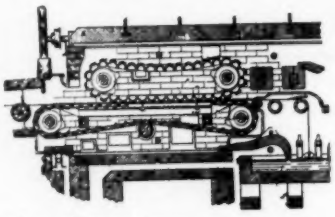
The use of oil in industry is increasing at such a rate that it becomes more and more necessary to consider the application in each individual field. On account of the many subjects covered in this volume the treatment of necessity has been sketchy in some parts. The book contains numerous figures and tables.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Copies of United States Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

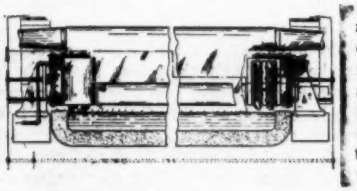
Apparatus for Stretching Sheet Glass. U. S. 1,444,038. Feb. 6, 1923. Clifford A. Rowley, of Toledo, O., assignor to The Libbey-Owens Sheet Glass Company, of Toledo, O.



This invention relates to the art of drawing glass in sheet form from a molten mass of glass, and is concerned more particularly with an apparatus for stretching the sheet laterally, while it is being drawn, to flatten the same and improve the quality of the sheet.

While the invention is adaptable to any form of sheet drawing apparatus, it is here shown as an improvement or addition to the apparatus disclosed in the patents to I. W. Colburn, 1,248,809, dated December 4, 1917, and 1,274,385, dated August 6, 1918. In this patented apparatus, a sheet of glass is drawn upwardly from a bath of molten glass, bent into a horizontal plane, reheated, and then passes through a drawing mechanism which gives the required longitudinal pull to draw the continuous sheet from its molten source, and at the same time flattens the reheated and softened sheet into its final form. The present invention so modifies this apparatus that the glass sheet is stretched laterally, while engaged by the drawing mechanism, to further flatten the sheet, and remove waves and wrinkles. In the present invention, the gripping devices, which grasp the edges of the sheet to pull the sheet longitudinally, are simultaneously moved laterally to stretch the sheet in width. In this way, a steady and substantially uniform tension is applied in all directions over a considerable area of the sheet, to draw out waves or corrugations and produce a smooth and flat sheet.

Width-Maintaining Apparatus for Continuous-Sheet Glass. U. S. 1,444,039 Feb. 6, 1923. Clifford A. Rowley, of Toledo, O., assignor to The Libbey-Owens Sheet Glass Co., Toledo, O.

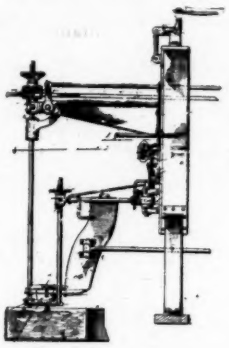


This invention in the art of drawing continuous sheet glass relates more particularly to an apparatus for maintaining the width of the sheet, and stretching the sheet laterally, while the sheet is still in a semi-plastic condition.

While the present invention is not limited to use with any one system of producing sheet glass, it is illustrated as adapted for an apparatus of the general type set forth in the patent to Colburn, 1,248,809, granted Dec. 4, 1917. In this well-known system a continuous sheet of glass is drawn upwardly from a bath of molten glass, and then, while still in a plastic condition, is bent into a horizontal plane and carried off through a suitable drawing mechanism and into the lehr. As is well-known in this art, unless some means is provided to maintain the width of the drawn sheet, it will gradually narrow away until no sheet is left. The present invention discloses a new form of apparatus for holding out the edges of the sheet as formed, to prevent narrowing, and at the same time an additional lateral tension is applied to the sheet to stretch it toward the edges and flatten it and remove wrinkles and waves. Specifically, the invention employs a series of rotating screws which yieldingly engage the edge portions of the sheet and simultaneously feed the same upwardly and outwardly.

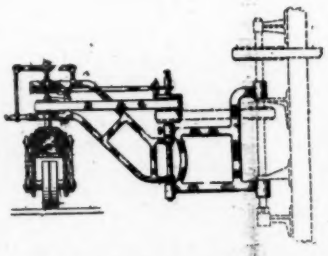
Glass-Shearing Mechanism. U. S. 1,444,327. Feb. 6, 1923. Theodore K. Byrd, of Baltimore, Md.

In the production of glass ware, wherein a machine is provided of the "Owens" type for example, having a plurality of dipping heads for gathering the molten glass from a tank, it frequently happens that an unsightly shear mark or scar is found upon the product and in many instances to such an extent as to render the article unsalable. At present it is customary to provide a knife, the shearing edge of which co-operates with the bottom of the blank mold to sever the glass drawn up into the mold from the string or neck lifted from the molten mass in the tank. This construction has been found to be highly objectionable in that the knife frequently strikes the bottom of the mold and in a very short time the glass is more nearly chewed off as if struck by a dull instrument, than cleanly severed. It is now necessary to sharpen the blank molds at frequent intervals by removing and turning them in a lathe. This operation is both tedious and unsatisfactory in that a large amount of time is lost, and in addition the mold blanks are shortened, thereby reducing the length of the pattern and the resulting product.



It is an object of the present invention to overcome these experienced difficulties and produce a shearing mechanism operable immediately beneath and independent of the bottom face of the blank mold, thereby increasing the longevity of use of said mold, and eliminating the shear mark or scar. Another object of the invention is the production of co-operating shearing members, one of said members constituting a shearing blade, and the other of said members forming a shear plate against which the former member operates to sever the glass, said shear plate being interposed between the bottom of the blank mold and the aforesaid shearing member.

Glass-Polishing Machine. U. S. 1,444,225. Feb. 6, 1923. William C. Walker, of Monroe Township, Madison County, Indiana.

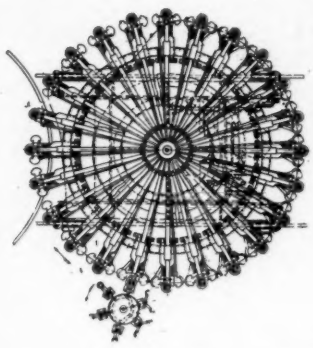


This invention relates to a machine that is designed to operate on horizontal sheets or plates of glass to polish the surface thereof, the invention having reference more particularly to a glass-polishing machine that may have a permanent support for guiding it, or may have a portable support so that the machine may be readily moved from place to place as may be desired instead of moving the glass to the permanently supported machine.

An object of the invention is to provide a glass-polishing machine of such construction as to operate rapidly and efficiently in removing or eliminating scratches or other blemishes or defects from the surface of the sheet glass, especially plate glass, whether newly made or previously used glass sheets, for the purpose of restoring the original polished surface or correcting defective portions of the surface to correspond with the originally perfect surface.

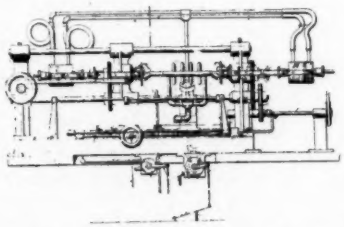
Machine for Making Pressed Glassware. U. S. 1,445,345. Feb. 13, 1923. Thomas C. Moorshead, of Alton, Ill.

Among the inventor's claims is a machine for making pressed glassware, comprising, a source of glass supply, a mold, a receiver adapted to gather a measured quantity of glass from said source, means for dipping and for exhausting said receiver to gather the glass including main and auxiliary valves in series, said main valve being adapted to remain open for the full dip of said receiver, and said auxiliary valve being adapted to close before said receiver rises, means for depositing the glass in said mold, and a former adapted to cooperate with said mold to press the glass to shape, mechanism for removing the formed article from the mold, comprising an ejector movable through the bottom of the mold, movable over the top of said mold to be engaged by the article, and means for moving said ejector and said retainer in cooperative relation, adapted to move said retainer over said mold and thereafter raise said ejector and said retainer with the article.



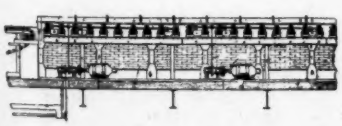
Glass-Blowing Machine. U. S. 1,446,026. Feb. 20, 1923. Miner P. Wetmore, of Newark, N. J., assignor to Hygrade Engineering Co., Inc.

This invention relates mainly to machines for glass blowing and is particularly adapted for use in blowing bulbs for incandescent electric lamps, though certain of the novel mechanisms therein embodied may be used in lathe chucks, etc. In machines of the character specifically mentioned above lengths of glass tubing are held between oppositely disposed revolving chucks which grasp and stop up the two ends of each piece of tubing, except for a small opening at one end, and rotate the same in the heating zone of a set of gas burners, while compressed air is admitted to the tube interior through the opening in the chuck at one end, and a mold of the proper shape is swung up and held against the swelling bubble of hot plastic glass which is formed by the expansion of the compressed air in the tube interior. Such machines as heretofore built have been slow and clumsy in operation, the operator having to directly manipulate all the clutch jaws, valves and other mechanisms separately. In the invention the chuck jaws are operated simultaneously by power and all control means are conveniently assembled so that the operator can blow the bulbs at greater speed and with much less manual effort than with the old machines.



Lehr Conveyor. U. S. 1,447,649. Mar. 6. 1923. Harry S. Deputy, of Charleston, W. Va., assignor to the Libbey-Owens Sheet Glass Company, of Toledo, O.

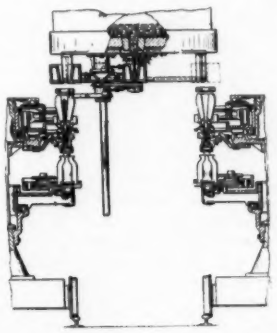
This invention relates particularly to an improved conveying system for carrying a continuous sheet of glass through a long lehr, or annealing oven, without unduly marring the surface of the sheet.



In lehrs, such as referred to in Colburn patent 1,248,809, the entire series of sheet supporting lehr rollers is driven as a unit, either by gearing them directly to the sheet drawing machine, or by driving the entire series from a single motor. In this way all of the rollers are driven at the same peripheral speed. Now the sheet of glass will contract as it cools, and due to the extreme length of the sheet the amount of this contraction will be very appreciable from end to end of the lehr, and will cause a material variation in the speeds at which the hotter and cooler ends of the continuous sheet are traveling. In other words, if the rollers are all driven at the same speed of rotation, and at such a speed as to conform exactly to the speed at which the hot glass is fed to them from the sheet drawing apparatus, the sheet as it cools and contracts will slow up so as to somewhat lag behind the rollers at the cool end of the lehr. This will cause a relative movement between the sheet and the surface of some of the rollers which tends to scratch and mar the fine fire polished surface of the drawn sheet. The object of this present invention is to so construct and drive the supporting rollers by making them of different diameters that their surface speeds will more approximately conform to the speed of the glass sheet at all points throughout the lehr and thus avoid the marring effects above referred to.

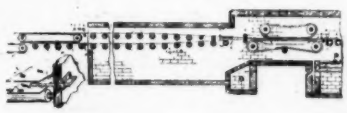
Means for Transferring Glass to Molds. U. S. 1,446,670. Feb. 27, 1923.

This invention relates to apparatus for receiving glass from a molten supply, forming it into gobs or charges, and transferring them to molds. An object of the invention is to provide improved means for feeding a number of machines, such as glass pressing or blowing machines, with gobs from the same furnace outlet or source of supply.



In its preferred form the invention comprises two transfer cups mounted on a reciprocating carrier by which they are brought alternately beneath an outlet opening of a furnace or container from which the molten glass is supplied. While the glass is flowing into one cup to form a gob, the other cup is over the mold of one machine and discharges thereinto. The carrier is then shifted to bring the cup which has just been discharged into glass receiving position, the other cup at the same time being moved with its charge into position to discharge into the mold of a second machine.

Method of and Apparatus for Drawing Sheet Glass. U. S. 1,447,654. Mar. 3, 1923. Arthur E. Fowle, of Toledo, O., assignor to the Libbey-Owens Sheet Glass Co., of Toledo, O.

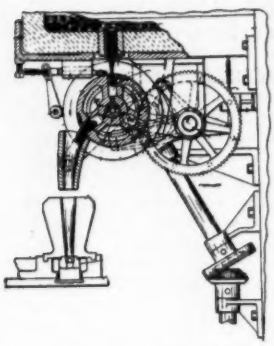


In the application of Joseph P. Crowley, serial number 386,440, filed June 4, 1920, is disclosed a system of drawing sheet glass wherein a pair of sheets are drawn vertically from a bath of molten glass, and after becoming partially set so that they will not adhere to one another, are brought into contact and bent collectively about a single bending roller and then passed through a single drawing mechanism and into a lehr.

In the present system the sheets are drawn, as before, in separable contact with one another but as they enter the lehr, mechanism is provided whereby the sheets are separated and conveyed individually through the lehr from which they emerge onto individual cutting tables. In this way both surfaces of each sheet are exposed throughout the travel of the sheet through the lehr, thus securing more uniform and satisfactory annealing. Also since each sheet emerges separately onto its own cutting table the process of severing the respective sheets into suitable lights or sections is greatly facilitated.

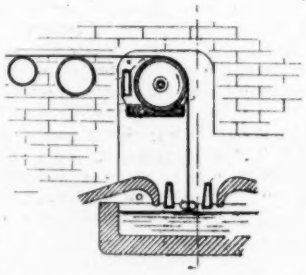
Means for Transferring Molten Glass. U. S. 1,446,649. Feb. 27, 1923. John Murl Lents, of Evansville, Ind., assignor to the Owens Bottle Company, of Toledo, O.

This invention relates to apparatus for separating a stream of molten glass into individual masses or gobs and transferring them to molds. An object of the invention is to provide means to receive the flowing glass, form it into elongated masses or gobs of suitable shape for entering the molds, and invert said gobs during their transfer so that the hottest portion of the gob will enter the mold first. Such an arrangement is particularly desirable in the manufacture of bottles and the like in which the mold receives its charge while in inverted position, that is with the neck end of the mold downward. By inverting the gob during its transfer to the mold the hottest portion of the glass is used to form the neck end of the bottle, which is desirable because of the rapid cooling of this portion of the mold, and because hotter and more plastic condition of the glass is required to perfectly form the comparatively small and irregular neck end than the body of the bottle. A further object of the invention is to provide a simple and practical arrangement for rapidly transferring the glass to the mold and in which the gob as it enters the mold is at an approximately uniform temperature throughout.



Apparatus for Bending Continuous-Sheet Glass. U. S. 1,447,647. Mar. 6, 1923. Joseph P. Crowley and Clifford A. Rowley, of Toledo, O., assignors to the Libbey-Owens Sheet Glass Company, of Toledo, O.

In some systems of producing sheet glass it is found desirable to bend the sheet, while still soft and workable, from a vertical into a horizontal plane. This has been successfully accomplished by passing the sheet partially around a cooled bending roller of some hard and heat-resisting metal, having a finely polished surface. However, as soon as the surface of the hard metal roller becomes worn, scratched or marred, the impressions of these imperfections are carried into the glass sheet passing thereover and reduce the quality of the article produced. Many different metals have been tried but none of them retain their highly polished surface for any great length of time, and it is frequently necessary to remove the rollers and clean and regrind the surface. It is the object of the present invention to provide a hard metal bending roller carrying a continuously renewed surface or film of softer metal or its equivalent, over which the glass sheet is passed and bent without injury to its surface.

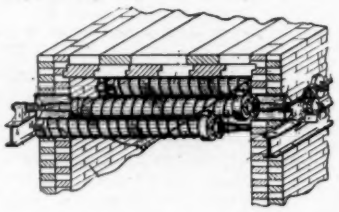


Crusher and Pulverizer. U. S. 1,439,754. Dec. 26, 1922. Harold M. Plaisted, of St. Louis, Mo., assignor to Williams Patent Crusher and Pulverizer Co., of St. Louis, Mo.

The main object of my invention is the provision of a rotor having hammers that are pivoted relatively near the hammer circle and extend circumferentially from their pivot (instead of radially from the center of the rotor as usual) and have a normal outward tendency so that they react inward practically radially under the resistance of the material being crushed between said hammers and a breaker plate and cage cooperating therewith.

Lehr-Conveyor for Continuous-Sheet Glass. U. S. 1,447,648. Mar. 6, 1923. Fernard E. Deulin, of Charleston, W. Va., assignor to the Libbey-Owens Sheet Glass Company, of Toledo, O.

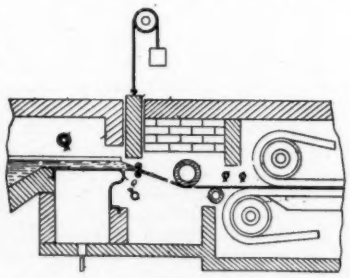
This invention relates especially to an improved form of lehr-conveyor for transporting a continuous sheet of glass through a lehr with a minimum amount of injury to the glass sheet.



The object of the present invention is to provide a conveyor roller, having an efficient, non-scratching and easily and quickly renewable sheet contacting surface. Specifically, and in the preferable form of the invention, the roller is provided with a soft metal wire, wound spirally around, and secured to, the cylindrical sheet-carrying surface. This wire is of a non-scratching material, and its small total mass makes its temperature quickly adjustable to accord with that of the sheet, and of the portion of the lehr in which it is located. Also, by properly spacing the coils of wire, the minimum of contacting surface sufficient to properly support the sheet may be easily provided.

Method and Apparatus for Drawing Sheet Glass. U. S. 1,447,702. Mar. 6, 1923. James Whittemore, of Detroit, Mich., assignor to the Libbey-Owens Sheet Glass Co., Toledo, O.

In the apparatus of the Colburn patent 1,248,809 the glass is drawn against the bending roll by the entire drawing pull of the drawing mechanism, and the bending roll also sustains the entire weight of the glass which is below the roll; so that the pressure of the glass on the bending roll is very material. With this improved method and apparatus, the inventor claims, the glass is pulled downwardly from the tank or pool to the drawing mechanism, so that the glass sheet is, in effect, sustained between the drawing point and the drawing mechanism,—while the bending roll does not carry any of the load of the sheet. The only pressure on the bending roll by the glass is the tension of the draft, and if the relationship between the drawing point and the drawing mechanism is as shown in this form of the apparatus, not only is the pressure contact of the glass greatly reduced but also the area contact is materially reduced, so that the marring effect of the bending roll is quite neglible.



Patents Recently Adjudicated

(U. S. C. C. A. Pa.) Chambers patent, 762,880, and Lubbers patent, 822,678, for apparatus and method for drawing glass cylinders. Held not infringed. Window Glass Machine Co. v. Pittsburgh Plate Glass Co., 284 Fed. Rep., 645.

(U. S. C. C. A. Pa.) Speer and Harvey patent, 828,147, for treatment of drawn-glass cylinders for flattening. Held void for lack of invention. Window Glass Machine Co. v. Pittsburgh Plate Glass Co., 284 Fed. Rep., 645.

(U. S. C. C. A. Pa.) Hart patent, 841,011, for method of cooling glass cylinders while being drawn. Held not infringed. Window Glass Machine Co. v. Pittsburgh Plate Glass Co., 284 Fed. Rep., 645.

(U. S. C. C. A. Pa.) Lubbers patents, 886,618 and 1,020,920, for apparatus and method of drawing glass cylinders. Held not infringed. Window Glass Machine Co. v. Pittsburgh Plate Glass Co., 284 Fed. Rep., 645.

(U. S. C. C. A. Pa.) Lubbers patent, 914,588, for method of drawing glass cylinders. Held not infringed. Window Glass Machine Co. v. Pittsburgh Plate Glass Co., 284 Fed. Rep., 645.

Glass Factory Equipment and Supplies

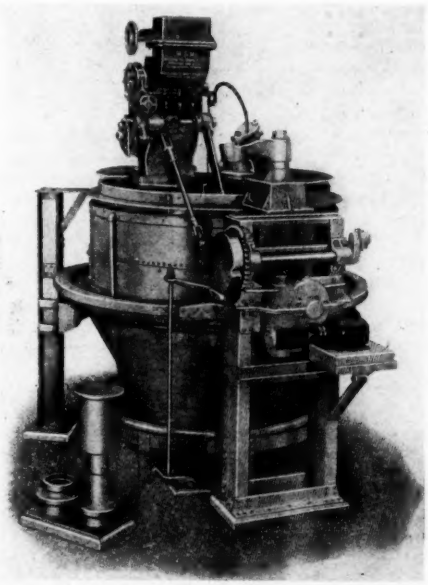
THE GLASS INDUSTRY will be glad to publish descriptions of new and useful devices, machinery and supplies of interest to the glass manufacturing trade. Most of the information printed in this department comes direct from the manufacturers of the products described.

Improved Gas Producer

A gas producer which is stated by the builders to embody many improvements over the standard Hughes type while retaining all of the valuable features of that design, has been announced as ready for the trade by the Wellman-Seaver-Morgan Company, Cleveland, O.

The new machine, known as type L No. 8 is self-contained and entirely automatic from coal feed to ash disposal. The poker action has been remodeled. The driving mechanism has been simplified. Hand poking is eliminated. The ash pan rotates intermittently. A combined steam-jet and turbo blower has been provided. Better mechanical efficiency, larger gas-making capacity, more uniformity in quality of gas, elimination of clinkering of the brick lining, and reduced maintenance cost are claimed.

The producer is said to have a gasifying capacity of 1,500 to



W-S-M GAS PRODUCER, TYPE L, NO. 8

2,750 pounds of bituminous coal per hour. Using the most desirable fuel, having 30 to 40 per cent. volatile matter, 50 to 60 per cent. fixed carbon, with less than 15 per cent. ash, the latter fusing at 2,200 F. or over, the producer is claimed to have an overload of over 3,600 pounds.

The producer is equipped with a W-S-M mechanical coal feed which measures and regulates the rate of coal delivery. The oscillating water-cooled mechanical poker extends from the top down into the fuel and combustion zone. It is mounted in a large circular bearing and is inclined at an angle to the vertical, oscillating in a path which forms the frustrum of a cone. Provision is made by means of a safety device for releasing the drive should unusual resistance be encountered by the poker. The life of the poker is prolonged by water-cooling and by making the tip of special steel. From the poker the water is discharged onto the top plate and thence by overflow pipes to the top water seal, then on to the ash pan seal. From 5 to 7 gallons of water per minute are consumed.

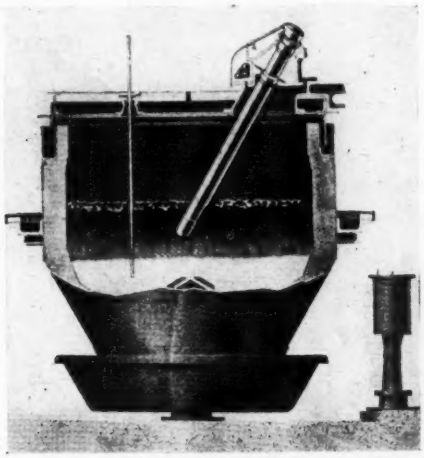
The producer is equipped with both the W-S-M steam injector blower and a steam turbo blower. Either may be used as the fire conditions indicate. The advantage of the turbo blower lies in the fact that the quantities of air and steam of the blast are independent of each other, and that the humidity of the blast as indicated by its saturation temperature is susceptible of the closest regulation.

The blast hood is a casting having conical sides from under which the blast passes from the central duct into the ash zone. Ribs on its upper surface assist in the down flow of the ashes to the ash pan. The hood and its blast pipe are carried and revolve with the ash pan. The shape and size of the hood are such as to secure an evenly distributed flow of the blast to the combustion zone.

The ashes are assisted in their descent from the combustion zone by the down stroke of the poker, and the combined action of the hexagonal hood and the intermittent rotation of the ash pan. This action also has the effect of crushing the clinkers that may be formed. Scraper blades supported from the lower water seal move the ashes to the outer edge of the pan where they come in contact with the ash plow which discharges them alongside the producer. The ash pan is carried on a ball bearing supported in a heavy cylindrical casting resting on the foundation. This casting serves also as a part of the blast duct. The ash pan rotates independently of the shell, being driven by the torque transmitted through the ashes.

The intermittent rotation of the pan is obtained by stop blocks which engage with an oscillating arm, which derives its periodic motion from a cam and block in the producer drive. The ash plow is adjustable and can be raised or lowered into the pan at will.

The producer is driven by a 3 horse-power motor and as only 1½ horse-power are required, an ample margin of power



SECTIONAL VIEW SHOWING WATER COOLED POKER AND ZONE MEASURING ROD

is provided against accidental overloads. A flexible coupling connects the motor to a double worm and gear reduction, which runs submerged in oil.

All bearings other than the reduction gear are lubricated by a forced grease system under high pressure, which it is claimed provides perfect lubrication and prevents grit from getting to the bearings.

A crank on the first worm wheel shaft operates the poker mechanism, coal feed and ash pan stop, while the main driving pinion is mounted on the second worm wheel shaft.

The arrangement of turbo and jet blower in combination, calls for a slightly different form of manipulation than for the simple jet type. To begin with, it is not intended to operate these two systems simultaneously. The reasons for supplying the two systems are: to ensure certainty of operation; provide means for operating the producer should an accident occur to either of the systems; and for coals carrying an excessive amount of sulphur. In the latter case, the air supply is cut to the minimum and a large amount of steam used.

The Glass World and What It Is Doing

News of the Industry

Glass Trade and Industry in India

By JANET H. NUNN*

Recent developments in India's industrial life have attracted attention to the immense trade of glass in that country, the natural resources of various sections for the production of glass and the attempts being made toward supplying the local demands. Previous to the war India imported from Germany 28 per cent of the lampware used; 28 per cent from Austria-Hungary; 11 per cent from Belgium and 8 per cent from England. In 1917-18 England's share had dwindled to 6 per cent, the other European countries had practically dropped out of this phase of the glass trade, while Japan had jumped from 5 per cent to 88 per cent. In tableware Japan's sudden rise was as marked, from 24 per cent to 70 per cent in the same period. In 1912-13 Belgium was furnishing 64 per cent of the sheet and plate glass imported into India, Germany 18 per cent and England 16 per cent. By 1917-18 Japan was in the race for 40 per cent of the trade while England furnished 50 per cent.

The following tables will show the changes in the entire glass trade as it stands now compared with 1913-14:

VALUE OF GLASS AND GLASSWARE IMPORTED INTO INDIA

Kinds	1913-14	1919-20	1920-21	1921-22
	Values in Rupees.			
Bangles	8,044,813	5,113,862	9,625,194	6,078,426
Beads	2,443,883	1,994,232	4,509,226	3,335,962
Bottles	2,192,672	3,006,649	5,456,777	3,367,930
Lampware	1,793,144	1,889,646	1,841,508	1,653,432
Scientific glassware	.....	55,386	213,978	164,087
Sheet & plate glass	2,235,337	3,600,536	7,111,083	3,794,707
Tableware	795,934	1,645,654	1,545,327	1,734,993
Other kinds	1,947,048	2,674,977	3,458,730	2,119,895
Total	19,452,831	19,980,942	33,761,823	22,349,432

Distribution by Countries	1913-14	1919-20	1920-21	1921-22
	Values in Rupees.			
Great Britain	2,620,486	3,255,376	6,667,069	4,435,114
Germany	2,858,651	3,005	2,032,420	3,144,831
Belgium	1,935,358	1,050,730	4,667,287	2,386,702
Austria-Hungary	8,738,151	632,290	4,326,713	559,488
Czecho-Slovakia	.....	.....	.....	1,485,041
France	434,832	1,030	11,924	not reported
Italy	489,440	325,468	1,044,351	459,437
Japan	1,581,299	13,107,783	13,107,783	8,568,574
Other countries	794,614	1,605,260	1,904,276	1,210,245
Total	19,452,831	19,980,942	33,761,823	22,249,432

Note: Figures for 1921-22 subject to revision.

In view of the high customs import duty, the extensive and growing local demand for glass articles and the marked increase in price which affects the actual quantity imported, the need for up-to-date glass factories in India is being clearly demonstrated. Raw materials for its manufacture are available in large quantities in various sections of the country, yet capitalists have been slow to invest in such adventures.

The industry is not new to India. According to ancient records, glass of a superior quality was manufactured there centuries before the present era, but few if any traces of this early phase survive. By the middle of the sixteenth century, however, there was an established cottage industry producing largely bottles and bangles in a primitive fashion and of an inferior quality. Little progress was made beyond this stage until about 1895 when European firms made some pioneer efforts toward improvement. Part of these Indian concerns failed utterly, while others were barely clinging to life when war conditions compelled India to increase her manufacturing facilities along certain lines if the demand for commodities was to be even partially satisfied. Austrian, German and Belgium sources for glass were closed, England's activities were diverted to other channels and prices advanced very noticeably. Old glass factories were revived and new ones established, which, however, produced only cheap kinds of lampware and bottles on a small scale. While the total production of these glass works may not be exactly estimated, the consensus of opinion seems to be that they were able to meet about one-half of the Indian demand for such wares during the latter part of the war.

In the present stage, there are two well defined classes of the industry, the cottage industry and the modern factories. The indigenous cottage glass industry, represented in all parts of India, but with its chief centers in the United Provinces and the extreme southern part of Bombay Presidency, manufactures mainly cheap bangles made from glass blocks obtained from the large glass factories. This is at present a flourishing industry and its estimated supply probably provides for one-third of the demand for these ornaments and amounted in 1921 to approximately 2,000,000 rupees ($500,000). Even though the great quantity of these bangles has been improved by the discovery of a new glazing process, the trade is facing very sharp competition from Japan with its new and attractive styles of bangles which seem to be ousting the old type of Indian ones.

The modern type of glass factory is just in its infancy in India. The existing factories either stop with the production of blocks for bangles, or with simple kinds of lampwares and bottles. Because of the present status of technical knowledge in the country regarding the industry and the lack of proper machinery, no effort is being made to produce sheet or plate glass, laboratory or fine table glass. Artistic glassware is out of the question and the commercial profits of the investor compel him to expend money and labor cautiously under existing conditions. Attention has been drawn, however, to the possibilities of state aid in the well directed efforts for development and competitors are anticipated in localities where successful ventures have been made.

The preventable causes of failures, both pre-war and later, have been attributed, it seems properly, to lack of good management and of proper commercial backing, due to the proprietor's dividend interests in numerous investments; to failure in the initial stages of concentration of efforts upon one kind of glass products, instead of several; and to the dire need of fluid capital to provide for the initial expenses connected with machinery for improvements and for the ordinary running expenses.

Over and above these causes, however, were special causes contributing to the failure of some and the hindrance of others. There are few glass experts in India as well as a dearth of technical literature to serve as guidance in this line. The number of skilled native glass blowers is limited. They are as a rule illiterate and not amenable to regulations in a co-operative industry. Fuel is expensive and the glass works being near the clay beds are consequently, in most cases, remote from coal beds and from proper marketing facilities. Competition from Japan and European countries necessarily retard any attempt at industrial progress—a condition, however, which the state policy of favoring home industries will gradually alter.

In 1921 there were 14 glass factories reported located in Bombay, the United Provinces, Punjab, Central Provinces and Calcutta, only three of which manufactured bottles. In discussing the future of the industry, the Industrial Commission in one of its reports calls attention to the fact that "the glass industry, in even its simplest form, is highly specialized and can be efficiently conducted only by scientifically trained managers and expert workmen. The present stage in India has been reached by importing men from Japan and Europe only partially equipped with the necessary qualifications, and by sending Indian students abroad to pick up what knowledge they can." The glass industry, at its best, is a closed trade and many of its secrets are carefully guarded so that the latter method has not proved conspicuously successful.

For the future guidance of manufacturers, it must be carefully noted that the alkali used in the glass factories in India now is

*Regional Assistant, Far Eastern Division, U. S. Bureau of Foreign and Domestic Commerce.

almost entirely an English product, carbonate of soda 98 to 99 per cent, in a powdered form, which has superseded the alkali earths formerly employed, but which have been discarded since the keen competition of high grade articles.

The latest official returns, August, 1922, regarding industrial enterprises recently established calls attention to a company in Calcutta with an authorized capital of 300,000 rupees ($100,000) organized for the manufacture of glass and with provisions made for overcoming former difficulties.

Burma receives practically 7 per cent of India's importation of glass and is increasing this amount by active manufacturing. About the middle of 1922 a Chinese firm established a factory in Rangoon for manufacturing glass chimneys from broken glass, the product being reported as equal to the imported article of like price. Trained glass blowers from China are engaged at a monthly wage of 60 to 80 rupees ($20.00 to $26.33) per month. Tableware is also manufactured in limited quantities.

Another attempt to solve the local demand for more glass was made by an enterprising native, who, after picking up what knowledge on glass manufacture was available in the Punjab, despite the difficulties facing a pioneer industry of a highly technical nature, coupled with the unsuitability of the out-of-the-way site selected, was able to make sufficient headway to induce some of his fellow countrymen to finance the undertaking, and convert the factory into a limited liability company established in Rangoon where it is reported as operating successfully.

[An informative article by G. P. Ogale on the "Glass Industry of India," was published in the *Journal of the American Ceramic Society*, Vol. 5, No. 11, (November) 1922, pp. 295-298.—EDITOR.]

Glass Bangles

The writer of a very interesting article published recently in an Indian paper expresses wonder that the manufacturers of glass have not turned their attention to the glass bangles which are so extensively used in India by all castes, and for which there is a never ceasing demand. As a matter of fact the business is a far more important one than the glass makers in this country realize, for it is not only universal in India, but continuous, in that these fragile things easily break and *must* be immediately replaced, for the wearing of them is something more than an ornament.

Every girl in India from the age of five upwards wears glass bangles, and by the married ladies the bangle is considered essential. Just as a wedding ring is always worn and never removed by English women after marriage so the bangle is worn continuously by the Indian women, whatever their occupation may be at the moment, hence the breakage is great. Before the Great War this business was done chiefly by Germans, now the Japanese have captured some of the trade; it is, however, up to the British glass makers to supply this useful market.—*The Pottery and Glass Record.*

Co-Operative Foreign Trade Advisory Service

The organization of a Trade Adviser Service to act throughout the year as a medium for the interchange of experience on foreign trade problems, was announced recently by the National Foreign Trade Council, India House, New York.

This service, according to O. K. Davis, secretary of the Council, is intended to provide foreign traders with a confidential answer to those intimate, personal, or unusual problems which cannot be handled in a satisfactory manner through existing governmental or private agencies. It will be of very practical assistance to foreign traders in improving the technique of export organization, sales methods, foreign advertising, commercial credits, traffic management and other similar practical matters.

More than a hundred leading foreign trade executives from all parts of the United States, and many lines of industry have agreed to co-operate in this work, and to draw upon their own successful experience in order to help other foreign traders solve their problems.

The Trade Adviser Service of the Foreign Trade Council will enable the manufacturer entering the export field to obtain invaluable advice from those of more mature experience. It will also provide the experienced manufacturer with an opportunity to check up his policies and methods with those of others equally or perhaps even more experienced in the same field.

This advisory service is rendered without obligation to the inquirer and without remuneration to the adviser, solely with the bigger and broader point in view of assisting in the development of American foreign trade.

To secure the benefits of this service, the inquirer should submit his problem in writing to the Trade Adviser Secretary of the National Foreign Trade Council, 1 Hanover Square, New York, giving sufficient details and background to enable the advisers to visualize the problem in full. The inquiry will then be considered from all angles, and the reply will contain a digest of the advice of some of the best brains in American foreign trade.

The general chairman of the Trade Adviser Service is E. P. Thomas, President, U. S. Steel Products Company, A. E. Ashburner, American Multigraph Sales Company, is vice-chairman; and C. J. Warren, Remington Typewriter Company, is executive chairman.

The personnel of this service includes representative foreign traders in all parts of the United States, from such firms as the American Tool Works, National Cash Register Company, California Packing Corp., Eastman Kodak Company, Hupp Motor Car Company, U. S. Rubber Export Company, Henry Disston & Sons, Western Wholesale Drug Company, Lawrence & Company, Sherwin-Williams Company, International Harvester Co., Waltham Watch Company, W. H. Knox & Company, Pillsbury Flour Mills Co., Barber Asphalt Company, H. Lindenberg Manufactory, Oregon Export-Import Company, American Pitch Pine Export Company, Brown Shoe Company, Pfister & Vogel Leather Company, and Carter's Ink Company.

Life Insurance for Employees

In connection with the presentation of life insurance policies to its individual employees by the American Plate Glass Company, Kane, Pa., during the latter part of last year, Secretary John Willis of the company said that as part of their policy they have for a considerable time past had in force a bonus system under which they distributed to their employees an extra amount over their regular wages in proportion to the improved or better results they show in their work, but the company considered that the idea of distributing life insurance policies would be far better than making any cash gifts or donations as it would mean a practical and permanent benefit for the families of their employees for whose interest all right thinking employers in all organizations should be working, and they believe that the plan just carried out is appreciated by their employees.

They have spent considerable money in providing a well equipped community building with all the conveniences that the best of such buildings possess, and the insurance plan is but another indication of the company's policy of always being willing and ready to do anything that appeals to them as being for the interest of their workmen, when a spirit of co-operation is shown.

Production of Lime in 1922

Reports from the principal producers of lime received by the United States Geological Survey indicate that about 3,528,000 short tons of lime, valued at $33,057,000, was sold in the United States, including Hawaii and Porto Rico, in 1922. This quantity is more than 39 per cent greater than that sold in 1921 and only one per cent less than that sold in 1920. The average value per ton in 1922 is estimated at $9.37. In 1921 it was $9.83 and in 1920 it was $10.52.

The sales of hydrated lime in the United States in 1922 were estimated at 1,125,300 short tons, an increase of 42 per cent over those in 1921 and the largest yet reported. The estimated value of the hydrated lime sold in 1922 was $10,850,000, an average value per ton of $9.64. The average value in 1921 was $9.36.

The demand for lime was obviously better in 1922 than in 1921, but producers report that the market was very irregular. Prices fluctuated greatly throughout the year, but showed a decided downward trend. Lime for construction undoubtedly made the largest increase in production, and chemical lime also increased appreciably, but it is doubtful whether agricultural lime made any increase whatever.

Shippers Win a Point

Section 1 of Rule 41, Consolidated Freight Classification No. 3 has been suspended by the Interstate Commerce Commission, J. T. Hendricks, traffic director of the Glass Container Association, announced on March 24. The following is quoted from the Commission's order:

"Necessity for refusing articles in fibreboard boxes which will safely and securely transport the commodities contained although not conforming in all respects to the carriers' specifications is not here shown.

"As stated, the present provision is uniform throughout the United States, and it should be uniformly applied. The interpretation given it in official and southern territories should govern in western territory."

This will have the effect of permanently restoring the old Section 1 of Consolidated Freight Classification No. 2. Under this decision the carriers will be obliged to accept shipments in fibreboard containers regardless of whether or not they comply with the provisions of Rule 41, unless they can determine that the shipping containers are unfit to safely and securely transport the commodities contained therein.

Government Sues Alleged Eyeglass Trust

Suit to dissolve an alleged eyeglass trust was filed in the United States Court at New York recently.

Four of the largest corporations engaged in the manufacture of eyeglasses and other optical instruments are defendants. It is charged that they formed a combination which was in restraint of trade and violation of the Sherman law.

The companies named are the Kryptok Company, a New York corporation; the Bausch & Lomb Optical Company, Rochester, N. Y.; the General Optical Company, Mount Vernon, N. Y., and the trustees of the American Optical Company, Southbridge, Mass.

The assistants to the Attorney General stated that certain jobbers and distributors received concessions in buying which were not given to the trade in general.

Tariff Off Glass Sand

It is reported that through the efforts of the glass manufacturers of California aided by the San Francisco chamber of commerce, customs officials at Washington, D. C., recently placed glass sand on the free list, enabling glass factories to import Belgian sand as ballast at a very low freight rate. Representatives of the Illinois-Pacific Glass Company, the Pacific Coast Glass Works and the Philadelphia Quartz Company, operating in the San Francisco bay district, contended the collection of the duty would force them out of business.

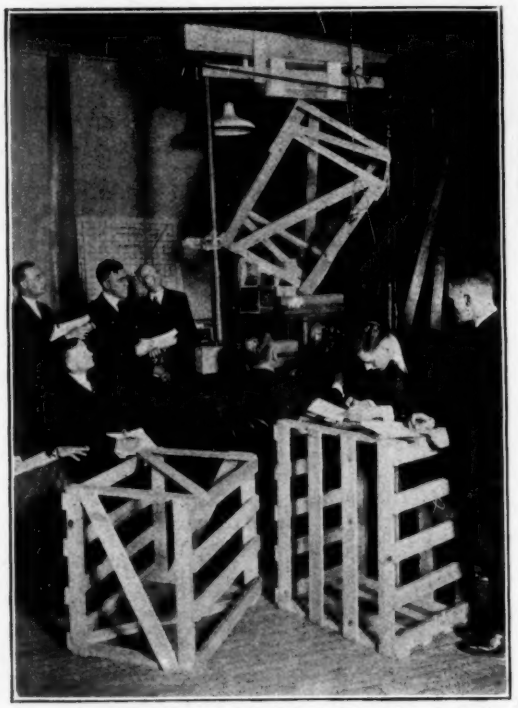
Production of Soda Ash

The production of soda ash in the United States during 1921 as announced early in March, 1923, by the Bureau of the Census is as follows:

	1921	1919	1914
Number of establishments....	20	18	10
Production—tons	959,780	1,507,424	..
For sale—tons	776,520	1,033,480	935,305
value.....	$29,355,800	$31,195,149	$10,937,945

The National Association of Manufacturers of Pressed and Blown Glassware held its annual meeting at Pittsburgh, Pa., in March and re-elected all of its officers for another year, as follows: E. J. Barry, Libbey Glass Manufacturing Company, president; C. B. Roe, Fostoria Glass Company, vice-president; J. D. Wilson, Tarentum, Pa., treasurer; John Kunzler, secretary, and C. E. Voitle, assistant secretary. The executive committee also re-elected is composed of: C. B. Roe, Fostoria Glass Company; M. W. Gleason, Gleason-Tiebout Glass Company; C. M. Rodefer, Rodefer Glass Company; T. W. McCreary, Phoenix Glass Company, and Reuben Haley, United States Glass Company.

There will be no compulsory "summer stop" in the flint glass factories this year an agreement having been reached between the manufacturers and the National Flint Glass Workers' Union under which factory employees will be permitted to take vacation periods in groups, but it has been agreed that not more than 25 per cent of the shop forces shall be absent at one particular period.



(Photograph furnished by the U. S. Forest Service)

Testing Crates

The testing of three common styles of crate bracing, for the instruction of a class in box and crate construction at the Forest Products Laboratory, U. S. Forest Service, Madison, Wisconsin, is here shown in progress.

The crate with a single diagonal brace on each of the six sides, under compression in the test machine, will withstand double the amount of diagonal compression that would cause serious distortion in the crate on the floor with the multiple parallel slat bracing. The diagonal bracing on the crate under test gives a maximum of rigidity with a minimum amount of lumber.

Bracing of the type used on the crate on the floor to the right affords little resistance to weaving and skewing (diagonal distortion) during transportation.

A combination of diagonal and parallel slat bracing, as shown on the crate to the left, is useful only in packing contents which need protection on the sides but are rigid enough to endure stresses diagonally.

The General Electric Company has set aside a fund of $400,000, to be known as the "Charles A. Coffin Foundation," the income from which, amounting to approximately $20,000 per year, will be available for encouraging and rewarding service in the electrical field by giving prizes to its employees, recognition to lighting, power, and railway companies for improvement in service to the public, fellowships to graduate students, and funds for research work at technical schools and colleges.

The Federal Trade Commission recently ruled that a firm advertising as a manufacturer and not owning or controlling a factory is engaged in unfair competition. An order has been issued, therefore, prohibiting any concern from advertising as a manufacturer, thereby leading purchasers to believe that they are saving the cost of a middleman, unless the concern actually owns and operates a factory.

A method of producing life-like imitations in glass of all kinds of fruit has been developed by A. W. Ayers, Box 1324, Wichita Falls, Texas. Mr. Ayers states that the glass is hand enameled with imported colors which will not fade.

Advises Deferring Government Construction

Secretary of Commerce Hoover in answering a question put to him by President Harding as to the policy which ought to be pursued in view of the present economic situation in the building industries, with a view to determining how much to speed up on the construction program to which the Government is committed, stated the following conclusion:

"For the Government to enter into competition at the present moment will give no additional employment to labor and no additional production of materials but must in the broad sense in the end displace that much private construction. The governments, nationally and locally, are in a much better position to hold construction work in abeyance than are private concerns, and are in better position to speed up in times of less demand as we did in the last depression as the result of the Unemployment Conference. We can by this means contribute something to a more even flow of employment not only directly in the construction work but in the material trades.

"I would recommend, therefore, that you direct the different divisions of the Government to initiate no new work that is not eminently necessary to carry on the immediate functions of the Government and that there should be a slowing down of work in progress so much as comports with real economy in construction, until after there is a relaxation in private demands."

The Federal Reserve Board already has put into force Secretary Hoover's recommendation by declining to approve the acceptance of a bid for a branch bank in Arkansas.

Trademarks; Trade Names; Unfair Competition.—In a 48-page pamphlet issued by Richards & Geier, 277 Broadway, New York, the subject of trademarks in the United States and in foreign countries is given attention, this being the third edition of the work. The booklet makes clear the proper use of trademarks and gives a number of examples of valid marks, as well as defining marks which are invalid. The questions of unfair competition and of duration of the right to use a trademark are taken up and discussed in some detail, as well as many other features of their use. Charges for trademarks in foreign countries are tabulated.

All February records for volume of construction contracts awarded were broken this year. The total in February, 1923, for 36 eastern states (including seven-eighths of the country's population) amounted to $281,140,000. This was a 16 per cent increase over January of this year. For the first two months of 1923 construction awards exceeded those of January and February, 1922, by 32 per cent.

It has been announced that the officers of the **Associated Glass and Pottery Manufacturers,** recently organized to foster and perpetuate the annual Glass and Pottery Exhibit at Pittsburgh, have been authorized to incorporate under the laws of Pennsylvania and that the next exhibit will be held January 7 to 26, 1924.

The fifth annual convention of the National Lime Association will be held at the Hotel Commodore, New York, June 13, 14 and 15, 1923. The work of the convention will be devoted in a large measure to reports from the technical men of the research organization, and from the field engineers of the Association.

There were 180 mirror manufacturing establishments in the United States reporting to the Census Bureau products valued at $5,000 or more in 1921. The value of the products shows a decrease of 19.6 per cent from 1919 to 1921, but an increase of 64.3 per cent for the seven-year period since 1914.

The National Bottle Manufacturers' Association and the **Glass Container Association** of America, will hold their spring meeting at the Marlborough-Blenheim, Atlantic City, N. J., April 26 to 28.

The Summer School at Carnegie Institute of Technology, Pittsburgh, Pa., will open June 25 with courses in the engineering, industrial and arts colleges and other subjects.

Standardized Engineering Symbols is the object of a movement inaugurated recently by the American Engineering Standards Committee. It is believed that great benefits would result from the adoption of standard abbreviations and symbols in technical, scientific and other fields.

Verified News of Trade Activities

Reports published in trade journals regarding the voluntary liquidation of **Thomas Webb & Sons, Ltd.,** referred to the old company which owned the Dennis Glass Works at Stourbridge, England. The old company went into voluntary liquidation on the sale of the assets to Webb's Crystal Glass Co., Ltd., and a new company was then formed under the name of Thomas Webb & Sons, Ltd., the shares in which are owned by Webb's Crystal Glass Company, Ltd. The liquidation in no way affects the present company of Thomas Webb & Sons, Ltd., Webb's Crystal Glass Company, Ltd., or any of its associated companies.

It is reported that the **Stark Glass Company,** which was recently incorporated at Massillon, O., for $30,000 will install a machine known as the Winder-Daubenspeck wide mouth jar machine invented by Henry C. Daubenspeck at the idle plant of the Rhodes Glass & Bottle Company, and if successful will manufacture the machine and wide mouth jars.

The Standard Conveyor Company, North St. Paul, Minn., has acquired the rights, titles and patents to all machinery manufactured by the Brown Portable Conveying Machinery Company, North Chicago, Ill. The plant at North Chicago will be continued until further notice and all correspondence regarding the Brown portable products should be addressed to Standard Conveyor Company, Brown Portable Products Plant, at that point.

The Premier Window Glass Company, Pennsboro, W. Va., recently struck a gas well which is said to have a capacity of 1,500,000 cubic feet daily, on a farm near Ellenboro. The product of this well, together with that of another of equal volume recently discovered on another farm nearby, will be piped to Pennsboro for use in the glass plants there and for domestic consumption.

The Long Beach Glass Company, 1550 Daisy avenue, Long Beach, Cal., formerly a sole proprietorship, was incorporated recently and is adding two new Lynch bottle machines to its equipment. The sand used in this and other California glass factories is said to come from Belgium as ships' ballast and to be obtainable at the cost of unloading.

The sale of the **Modern Glass Company's** plant is provided for in an order entered in the Federal Court, March 15, at Toledo, O., by Judge Killits. The sale must be advertised four weeks. No bid of less than $300,000 will be accepted. Should the reorganization committee purchase the plant payment may be made in allowed claims and preferred stock.

The Birmingham Glass Manufacturing Company, 29 S. La Salle St., Chicago, Ill., has been incorporated with a capital of $250,000 to manufacture glass products. The incorporators are: Harry C. Bryson, president; E. R. Owen, vice-president and general manager; Richard T. Robb, secretary; George A. Peterson and Glen E. McDorman.

The Gill Brothers Glass Company has closed down its plant at Steubenville, O. The Jefferson Glass Company, Follansbee, W. Va., according to C. H. Blumenauer, president, has made the Gill Company what they consider a very reasonable offer for the property but up to the present time no deal has been consummated.

Increases in wages averaging from 5 to 10 per cent have been given to workmen at the **American Plate Glass Company's plant** at James City, Pa.; at the Blairsville, Pa., plant of the **National Plate Glass Company,** a subsidiary of the Fisher Body Company and also at the **Edward Ford Plate Glass Company's plant** at Rossford, O.

It is reported that a contract for buildings at the **Edward Ford Plate Glass Company's** new plant at Rossford, O., has been let to A. Bentley & Sons Company and that the contract for the lehr and casting house equipment has been let to J. W. Cruikshank Engineering Company, Pittsburgh, Pa. Work has already started and will be rushed to completion.

The Maryland Glass Sand Company, Hagerstown, Md., has increased its capital from $150,000 to $250,000. The company has made improvements in its plant, adding electric shovels, engines and trucks, additional washers, a 6,000-ton drying bin and other electrical equipment to facilitate the output of it product.

Henry P. Fox, one of the younger stained glass craftsmen, of Providence, R. I., with studio at 73 Rugby street, was recently successful over a number of other prominent New England contestants in winning the award of a contract for 10 large memorial windows to be installed in a new church at Belchertown, Mass.

The Ruth-Hasting Glass Company, Conshohocken, Pa., manufacturers of glass tubing, has resumed operation at its plant after being shut down for several months. The company will increase its production in the near future by increasing its working force.

Lang's Daylight Limited, Industrial Island, Vancouver, B. C., manufacturers of "Lang's daylight reflectors" announce that having found a ready market in the west for their products, they are now negotiating with an eastern glass factory for the manufacture of their line for eastern distribution.

The optical department of Plant No. 1 of the **Pittsburgh Plate Glass Company,** Creighton, Pa., will be moved to the Charleroi plant. The new plant which the company is building at Creighton will be one of the largest plants in the world devoted exclusively to the manufacture of plate glass.

The Libbey-Owens Sheet Glass Company, Toledo, Ohio, has awarded the contract for an addition to its plant at Charleston, W. Va., to the American Bridge Company, Pittsburgh, Pa. It is stated that the steel work will cost about $100,000 and the complete building and equipment $1,750,000.

Edwin P. Corbett, attorney at law specializing in patents and trade marks, formerly located in the Huntington Bank Building, Columbus, O., has removed his offices to Suite 320-322 the Rowlands Building.

The Columbia Chemical Division of the Pittsburgh Plate Glass Company will erect a new plant at White Cottage, near Zanesville, Ohio, at an estimated cost of about $1,500,000, including machinery. The plant will consist of eleven one- and two-story buildings.

The Peerless Glass Company, recently organized at Wichita, Kans., will deal in windshield and automobile glass, headlight lens glass and window glass. Keith J. Adams is the sole owner of the company.

B. F. Drakenfeld & Co., Inc., 50 Murray street, New York, have been appointed sales agents for the well-known potash feldspar produced by the **River Feldspar & Milling Company,** Middletown, Connecticut.

Hazel-Atlas Annual Report

The annual report of the Hazel-Atlas Glass Company covering the year 1922 shows the company to have enjoyed one of the most prosperous years in its history. Net earnings for the year amounted to $1,592,792. After payment of dividends, by the Hazel-Atlas Company of $959,872 and by the Kearns-Gorsuch Company of $18,936, and premiums on retired preferred stock of Kearns-Gorsuch Company amounting to $22,635 and sundry items of $13,847 there remained at the end of the year a surplus of $1,835,048. The total assets of the company aggregate $15,340,771.

Early in March it was officially announced that the board of directors had decided that it was necessary to increase the working capital and that at the adjourned annual meeting of the stockholders to be held on March 20, resolutions would be offered for increasing the authorized capital stock from ten million dollars to fifteen million dollars; for changing the par value per share from one hundred dollars to twenty-five dollars; and for setting apart twenty-five thousand shares of such new stock to be offered for sale to employees and officers of the company at such price, not less than par, and on such terms, as the board of directors may determine from time to time.

These resolutions having been carried, it is proposed to offer each stockholder the right to subscribe for new stock, at par, to an amount equal to one-sixth of the par value of stock now owned. The new shares will be $25.00 par each and certificates will be issued on that basis. As an example, if a stockholder is entitled to $100.00 new stock, he will receive a certificate for four shares of $25.00 each; and if fractions accrue stockholder may consider such fraction as a right to purchase one full share for $25.00. No scrip will be issued for fractional shares.

Owens Bottle Company Annual Report

A statement distributed to stockholders of the Owens Bottle Company along with notice of the annual meeting to be held at Toledo, O., April 11, shows the company's net earnings for 1922 to have been $3,554,861, or at the rate of $4.42 a share, after paying all preferred dividends, compared with a net profit of $1,369,096 for 1921.

The income statement for last year shows a manufacturing profit of $2,907,370, income from royalties of $1,736,660 and other income from bonds and securities owned, gas sales, interest earned and profits on foreign rights and investments amounting to $1,576,609, or a total income of $6,220,640.

Expenses, depreciation, etc., amounted to $1,989,978, with taxes and contingencies of $675,800, which leaves the net profit of $3,554,861.

The balance sheet shows cash amounting to $4,965,790 and United States bonds and war savings stamps to the aggregate of $1,616,222. Receivables total $1,448,197 and merchandise inventory is $5,239,950, a total of current assets of $13,310,260 compared with current liabilities of only $1,516,433.

There is $9,053,500 of 7 per cent preferred stock outstanding, a slight reduction compared with previous year. There was $25,584,700 of common or 661,248 shares outstanding at the end of the year.

Outside of the stock and current liabilities there is a reserve of $3,109,353 set up for repairs, federal taxes and contingencies and a surplus of $4,923,282.

Pittsburgh Plate Glass Annual Report

The annual statement recently issued to stockholders of the Pittsburgh Plate Glass Company shows a surplus of $24,704,041 which was considerably reduced by the stock dividend of 30 per cent paid January 31, 1923. The statement for the year ended December 31, 1922, is as follows:

ASSETS

Investment	$35,832,825
Merchandise	$7,159,523
Material and working accounts	6,760,367
Bills and accounts receivable	15,632,462
Bond investments	2,661,645
Cash	2,267,645
Quick assets	$34,481,645
	$70,314.471

LIABILITIES

Capital stock authorized	$37,500,000
Less unissued capital stock	365,100
	$37,134,900
Sundry Credits—	
Bills payable	.....
Accounts payable (Current)	2,830,789
Insurance fund	324,535
Reserve for inventory deflation, obsolescence and other contingencies	3,748,871
Reserve for estimated Federal income taxes payable in 1923.	1,350,000
Reserve for employees stock contracts	221,333

PROFIT AND LOSS

Surplus January 1st, 1922	$20,159,586	
Unused portion 1921 reserve Federal income taxes	73,938	
Earnings 1922, less depreciation, obsolescence and reserve for estimated Federal income taxes payable in 1923	9,275,803	
	$29,509,329	
Less cash dividends paid in 1922	4,805,288	
Balance in surplus account December 31, 1922		$24,704,041
		$70,314.471

The net earnings for the year 1922 were $9,275,803, after deducting $2,681,935 for depreciation and obsolescence, and a reserve for federal taxes of $1,350,000. The reserve for possible inventory deflation was drawn upon in 1922 for inventory adjustments to the extent of $292,438, leaving a balance of $3,748,871, which as a conservative measure is held as a reserve for future inventory deflation, extraordinary

obsolescence of plant and equipment and other contingencies. Federal Income and Excess Profits Taxes on 1921 earnings, paid in 1922, amounted to $1,076,061, which was $73,938 less than the sum estimated and reserved out of 1921 earnings. This difference, $73,938, has been added to Surplus Account. After the above mentioned deductions and addition, and the payment of the regular cash dividends, there remained a balance of $4,544,454, which was added to Surplus Account, increasing that account to $24,704,041. This account has been reduced to the extent of about $11,150,000, on account of the 30 per cent stock dividend distributed to the stockholders January 31, 1923. Expenditures for additions to investments amounted to $3,263,198, but after the deduction of depreciation and obsolescence, the net increase in Investment Account amounted to only $581,263. For the fourth consecutive year, there were no bills payable. Current Accounts Payable were $2,830,789. Inventories have been taken as usual, at conservative values.

United States Glass Annual Report

Discussing the thirty-second annual report of the United States Glass Company for the year 1922, President M. G. Bryce said:

"The deflation that occurred during 1921 continued to a certain extent, during 1922 and while business secured during the January exhibition of 1921 indicated a gradual improvement, with normalcy not at a distant date, the facts were that while both selling prices and costs decreased for several months, suddenly costs commenced to increase but selling prices did not; and it was late in the Fall before things became anything like normal. However, the final results for the year 1922 were really better than could have been expected with the conditions under which we operated."

The balance sheet as of December 31 last follows:

ASSETS

Current—			
Cash		$132,283	
Notes and accounts receivable—customers..	$713,592		
Less allowance for doubtful accounts.....	25,000		
		688,592	
Inventory—raw material, glassware and supplies.....		1,020,463	
			$1,841,339
Other convertible assets—			
Capital stock—held in treasury—cost value.....		$16,965	
First mortgage bonds—held in treasury.....		1,300	
Other securities owned.....		9,070	
Cash value—life insurance.....		11,087	
Miscellaneous accounts receivable.....		14,612	
			53,034
Investment—Glassport Land Co.—			
Capital stock—book value of entire issue...	$611,975		
Open account	142,693		
		$754,669	
Less allowance for reduction of book value.....		404,669	
			350,000
Permanent—			
Land, buildings, equipment, etc., appraised by Manufacturers Appraisal Company at December 31, 1922, at $5,170,837.86, and valued for the purpose of this statement at.....			3,619,586
Deferred charges—			
Prepaid expenses, etc.			24,441
Total			$5,888,402

LIABILITIES

Current—			
Notes payable		$481,000	
Accounts payable		327,380	
Accrued accounts		22,253	
			$830,634
Funded debt—			
First General Mortgage 5% Gold Bonds—due September 1, 1923.			390,000
Reserves—			
For Federal taxes and contingencies.....			243,730
Nominal—			
Capital stock—issued and outstanding.....		$1,600,000	
Surplus—			
Paid in—par value of capital stock surrendered to the company.....	$1,600,000		
Capital—from appreciation in book value of capital assets, etc.—net.....	799,580		
Undivided—			
Undivided profits	424,456		
		2,824,037	
			4,424,037
Total			$5,888,402

Harbison-Walker Annual Report

The twentieth annual statement of the Harbison-Walker Refractories Company, Pittsburgh, Pa., shows surplus profit for 1922 of $803,571, after deducting $901,810 expenditures for ordinary repairs and Federal taxes, $557,793 for depreciation and depletion, $167,832 dividends on preferred stock and $1,508,136 dividends on common stock. The surplus at the end of the year was $5,747,028 compared with $4,943,457 on December 31, 1921.

The balance sheet showed the following condition:

ASSETS: Property account, $27,991,017; betterments completed, $3,094,878; betterments uncompleted, $48,026; deferred charges to future operations, $735,940; inventories, $1,951,848; accounts receivable, $2,830,403; notes receivable, $98,751; cash, $1,696,674. Investment of reserves, $1,020,976; other securities, $832,429. Total assets, $40,300,947.

LIABILITIES: Capital stock: Preferred (six per cent cumulative) $3,000,000, common $27,000,000, total $30,000,000; reserves: Clay, coal and ganister properties depletion, $450,078, sundry reserves, $3,304,510, total $3,754,588; current liabilities: accounts payable, $595,165.29, pay rolls $204,165.13, total $799,330; surplus $5,747,028; total capital and liabilities, $40,300,947.

It will be noted that the preferred stock has been reduced from the original issue of $9,600,000 to $3,000,000. This is in pursuance of the action of the stockholders at a special meeting held May 15, 1922. The annual meeting will be held Monday, April 16, 1923.

Inquiries Received

For further information address THE GLASS INDUSTRY

120.—Can you inform me where I can purchase No. 70 and No. 140 grain carbide of silicon?

121.—(From China)—Kindly put us in touch with concerns which can supply broken glass to be utilized in factories in China.

122.—We desire the names of importers who can furnish us with 2,500 lights of Belgian rib glass, one-eighth inch thick, in sizes of 12 by 22 inches and 12 by 17 inches.

123.—Can you tell me what is used for the black lettering on stop signals for automobiles and also how it is used?

124.—We would like to get in touch with European plate glass manufacturers.

125.—Can you give us the names of marble counter manufacturers and also manufacturers of show-case fittings?

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Pa.)

PITTSBURGH STOCK EXCHANGE, MARCH 26, 1923

	Bid	Asked	Last
American Window Glass Machine, com..	85	86	85
American Window Glass Machine, pfd..	94	95	95
American Window Glass Preferred.....	106	107	107
Pittsburgh Plate Glass.....	165	170	170
U. S. Glass (new stock).....	25	25½	25

The glass market for the last month has been quiet and the various issues maintained about the same level on scattered transactions. From the market action of various stocks, it would seem that the prosperous operation of various companies had been discounted.

WHEELING STOCK EXCHANGE, MARCH 26, 1923

	Bid	Asked	Last
Hazel-Atlas	164	165½	165½
Imperial Glass	99½	100½	99½
Fostoria Glass	130	...	130
Central Glass	90	100	90

The Wheeling glass market was fairly strong during the month and many of the issues made gains in price quotations. It is understood that the various companies are operating very near capacity and that earnings are running at an unusually satisfactory rate.

TOLEDO STOCK EXCHANGE, MARCH 26, 1923

	Bid	Asked	Last
Owens Bottle, common.....	49½	50½	50
Owens Bottle, preferred.....	107	114	110
Libbey-Owens Sheet Glass, com.	121	126	123
Libbey-Owens Sheet Glass, pfd.	104	108	107

Current Prices of Glass-Making Materials

From quotations furnished by various manufacturers and dealers

March 26, 1923

	Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)..lb.	.05	.05½
Aluminum oxide (Al_2O_3).....lb.	.05½	.06½-.07
Antimony oxide (Sb_2O_3).. ...lb.	.07	.07½
Arsenic trioxide (dense white), 99% (As_2O_3).....lb.	.15	.15½
Barium carbonate ($BaCO_3$)...ton	70.00	90.00
Barium hydrate ($Ba(OH)_2$)....lb.	.05½	.05¾
Bone ash .....lb.	.05	.06
Borax ($Na_2B_4O_7 10H_2O$) .....lb.	.05¼	.05½
Borax, fused, any mesh ($Na_2B_4O_7$) .....lb.	.19	.20
Boric acid, fused (B_2O_3).....lb.	.35	.35
Cadmium Sulphide, red (CdS)..lb.	..	1.65
Cadmium Sulphide, orange.....lb.	..	1.65
Cadmium Sulphide, yellow (CdS) .....lb.	..	1.90
Chrome oxide .....lb.	.35	.36
Cobalt oxide, in bbls. (Co_2O_3)...lb.	..	2.10
Cobalt oxide, in 10 lb. tins (Co_2O_3) .....lb	..	2.20
Copper oxide, red .....lb.	..	.15-.16
Copper oxide, black (CuO).....lb.	..	.26
Copper oxide, black prep'd (CuO) .....lb.	..	.30
Cryolite (Na_3AlF_6) .....lb.	..	.09½
Feldspar, 100 mesh.....ton	15.00	24.00
Fluorspar, powdered white, 95% (CaF_2) .....ton	35.00	45.00
Fluorspar, powdered white, 90% (CaF_2) .....ton	33.00	38.00
Hydrofluoric acid (HF) 60%..lb.	.14	..
Kaolin .....ton	17.00	25.00
Lead oxide (red lead) (Pb_3O_4)..lb.	.11½	.11¾
Litharge (PbO) .....lb.	.11	.11¼
Lime—		
Hydrated (in 50 lb. paper sacks) ($Ca(OH)_2$) .....ton	11.50	..
Burnt, ground, in bulk (CaO).ton	8.00	..
Burnt, ground, in paper sacks.ton	10.00	..
Burnt, ground in 280 lb. bbls. per bbl.	2.10	2.25
Manganese 85% (MnO_2).....lb.	.03¾	.04¾-.06
Nickel oxide, black (Ni_2O_3) for nickel content .....lb.	..	.50
Nickel monoxide, green (NiO) for nickel content.....lb.	..	.50
Potassium carbonate—		
Calcined 90% (K_2CO_3).....lb.	.06¼	.06½
Hydrated 90% (KOH) .....lb.	.07	.07¾
Potassium nitrate (KNO_3) (gran.) .....lb.	.06½	.06¾
Potassium Permanganate ($KMnO_4$) .....lb.	..	.17
Powdered blue .....lb.	..	.24-.26
Powdered blue (std. formula)..lb.	..	.38
Salt cake, glassmakers, f. o. b. works (Na_2SO_4) .....ton	25.00	30.00
Selenium (Se) .....lb.	..	1.95.-2.25
Soda ash, 58% dense, 48% basis Bulk (Na_2CO_3) .....100 lb.	1.22½	..
Bulk, on contract (Na_2CO_3) 100 lb.	1.17½	..
Sodium nitrate, refined ($NaNO_3$).lb.	..	.04¾-.06¼
Sodium selenite (Na_2SeO_3).....lb.	..	2.00-2.15
Sodium Fluosilicate (Na_2SiF_6)...lb.	.07¾	.08
Sulphur (S) (flowers)—in bbls. per 100 lb.	3.25	3.55–3.80
Sulphur (flowers) Bags per 100 lb.	3.00	3.30–3.55
Sulphur (S) (flour, heavy), in bbls. per 100 lb.	2.50	3.00
Uranium oxide—100 lb. lots (UO_3) .....lb.	..	2.25-2.50
Zinc oxide (ZnO) .....lb.	.07½	.08

Monthly Summary of United States Foreign Commerce in Glass

[NOTE.—The new tariff law, which became effective September 22, 1922, necessitated a revision of the statistical classification based on the new rates of duties for imports into the United States on and after that date. This means that in the September statements the imports from September 1 to 21 under the old law must be kept separate from imports after that date under the new tariff. In order to avoid the delay which would be caused by compiling two sets of import statements in one month, it has been decided to close the September report with imports under the old law to the 21st, inclusive, and to carry over the imports from September 22 to 30 under the new tariff to the October reports.]

EXPORTS

Corrected to March 13, 1923

	January 1922 Quantity	January 1922 Value	January 1923 Quantity	January 1923 Value	Seven Months Ending January 1922 Quantity	Seven Months Ending January 1922 Value	Seven Months Ending January 1923 Quantity	Seven Months Ending January 1923 Value
Glass and glass products (total).....	.....	$728,454	.....	$859,153	.....	$5,141,956	.....	$5,196,326
Plate and window glass—								
Window glass, common, box 50 sq. ft.....	1,466	9,405	3,586	20,966	10,281	69,420	18,406	106,237
Plate glass, unsilvered, sq. ft.....	305,588	112,112	225,249	85,909	1,137,270	533,268	1,227,510	471,323
Other window and plate glass, n. e. s.....lbs.	127,384	11,241	495,073	42,379	[2]127,384	[2]11,241	1,513,241	156,954
Glass containers (bottles, vials and jars).....lbs.	2,164,432	134,729	5,243,249	248,378	.....	1,485,395	30,712,775	1,571,609
Table glassware, plain.....lbs.	321,024	55,081	1,608,378	192,849	[2]321,024	[2]55,081	10,185,171	1,077,498
Table and other glassware, cut or engraved....lbs.	10,011	5,444	36,121	17,469	.....	66,494	342,416	134,162
Glassware for lighting—								
Lamp chimneys and latern globes.....lbs.	99,144	21,211	141,078	25,650	[2]99,144	[2]21,211	805,628	153,773
Globes and shades for lighting fixtures.....lbs.	95,895	35,272	101,199	27,235	[2]95,895	[2]35,272	932,266	254,389
Lamps and other illuminating devices, chiefly of glass .....lbs.	111,202	53,246	107,643	31,562	[2]111,202	[2]53,246	607,412	192,582
Chemical glassware .....lbs.	15,675	7,609	12,339	10,071	.....	94,714	117,502	78,869
Electrical glassware, except for lighting.....lbs.	81,028	12,082	191,789	15,332	[2]81,028	[2]12,082	1,748,453	111,818
Other glassware, n. e. s.....lbs.	1,121,515	271,022	602,446	141,413	.....	2,704,532	4,976,660	887,112

[2] Jan. 1 to Jan. 31.

IMPORTS

Corrected to March 9, 1923

	October, 1922[1] Quantity	October, 1922[1] Value	Nov., 1922 Quantity	Nov., 1922 Value	Eleven Months Ending November 1921 Quantity	Eleven Months Ending November 1921 Value	Eleven Months Ending November 1922 Quantity	Eleven Months Ending November 1922 Value
Glass (total)	.....	$1,816,497	.....	$1,415,960	.....	$8,907,263	.....	$12,487,626
Cylinder, crown, and sheet, lbs.....dut	.....	.....	.....	.....	44,496,847	2,474,072	[3]41,597,241	[3]2,085,182
Unpolished, lbs. .....dut	3,541,689	141,621	4,362,278	185,108	.....	.....	[2]7,903,967	[2]326,729
Bent, ground, beveled, colored, painted, etc., and polished .....dut	.....	72,284	.....	65,502	.....	.....	.....	[2]137,786
Plate glass—								
Unsilvered, sq. ft.....dut	1,731,030	849,121	1,351,247	654,942	2,631,009	1,812,007	9,304,518	4,323,794
Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft.....dut	251,606	52,286	128,068	25,164	.....	.....	[2]379,674	[2]77,450
Containers—bottles, vials, etc.....dut	.....	31,936	.....	24,748	.....	337,852	.....	277,568
Table and kitchen utensils, lbs.....dut	120,383	51,420	119,670	44,056	.....	.....	[2]240,053	[2]95,476
Glassware, cut or decorated, lbs.....dut	360,542	148,897	236,709	121,584	.....	1,357,616	.....	[1]1,943,671
Blown glassware, n. e. s., lbs.....dut	658,249	162,847	402,903	112,526	.....	.....	[2]1,061,152	[2]275,373
Other glassware ..... { free	.....	.....	.....	.....	.....	599,961	.....	[3]106,800
Other glassware ..... { dut	.....	306,085	.....	182,330	.....	2,325,755	.....	2,837,797

[1] Sept. 22 to Oct. 31. [2] Beginning Sept. 22. [3] Jan. 1 to Sept. 21.